# Subterranea

The Magazine for Subterranea Britannica

**Subterranea Britannica** **December 2018 Issue 49**

IN THIS ISSUE

Subterranea Britannica is a society devoted to the study of man-made and man-used underground structures and the archaeology of the Cold War. The society is open to all and its membership includes all walks of life. Members are invited to contribute to this magazine even if this just means sending very welcome snippets from newspapers and magazines.

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# Contents



**Front cover photo:** *The new ventilation and air filtration plant installed at the Highland Council Emergency Centre at Raigmore, Inverness in 1989. The racing bicycles, devoid of front wheels but otherwise complete with gears and rear brakes, are used to drive the ventilation fans in the event of a power failure. The same system was used in a number of UK bunkers during WWII. Photo Nick Catford*

**Back page upper:** *Rock Cemetery Sand Mine, Nottingham: The SubBrit group, unconcerned by the severely robbed pillar, are examining a hole in the roof. This was caused by water penetration and the consequent de-lamination of the sandstone. It is said that the hole resulted in one of the cemetery's occupants making an unintended descent into the cave. Photo Clive Penfold*

**Back page lower:** *SubBritters pose for the camera at the Papplewick Reservoir in October 2018 during the Nottingham weekend. Photo Gerald Tompsett*



Newsletters of Subterranea Britannica are published by the committee of Subterranea Britannica. Original articles, book reviews, press cuttings, extracts from books and journals, letters to the Editor etc are welcome. However the Editor reserves the right not to publish material without giving a reason.

The committee of Subterranea Britannica and the Editor do not necessarily agree with any views expressed and cannot always check the accuracy of any material sent in.



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# Chairman's Welcome

**Martin Dixon**

Our Autumn Conference this year was held in a new location for us – the British Geological Survey (BGS) in Keyworth near Nottingham. This is in line with our policy of holding every other Autumn meeting outside of London (building on previous successes in Liverpool, Newcastle and Belfast). We missed Chris Rayner's beaming smile and steadying hand but Chris Gray ably stepped into the role and put together a fascinating programme. As usual it was great to see members old and new and a great opportunity for networking.

Particular thanks are due to member Andrew Hughes, who works at the BGS, who made arrangements for us to use the facilities there. During the conference Andrew ran through the history and responsibilities of the BGS and attendees also had the opportunity to view the BGS Geological Walk and see behind the scenes in the 'core store' where a staggering 500 kilometres of core samples are held.


*Tony Waltham in full flow during his talk on Nottingham's caves*

The Geological Walk is a 130 metre-long journey through British geology, from Precambrian through to the Quaternary Age. Each Age in the paving has representative rock samples from across the UK and is open for public viewing from Monday to Friday.

An understanding of the geology is crucial in constructing underground structures – a theme that came across strongly in the presentations during the day. Tony Waltham and Scott Lomax told us the story of the Nottingham 'Caves' (which are of course entirely man-made), whetting our appetite for visits to be made later in the weekend. Chris Gray told the story of Victoria Railway Station and its lost tunnels and David Dawson described and illustrated his 1960s exploration of the Butterley Canal Tunnel on the Cromford Canal.

Butterley Tunnel is sadly no longer accessible but we are in the process of arranging a members' through-trip of Standedge Tunnel on the Huddersfield Canal; Standedge is the longest, deepest and highest tunnel on the British canal system – watch out for more details of the visit. We hope to make a few stops en route for photography but sadly we won't be able to disembark to explore the adits that lead to the three parallel railway tunnels.

Andrew Hughes' own speciality is hydrology and the study of ground water and he explained his work with reference to a number of underground structures. Water is of course a vital resource for humans but a potential hazard if it turns up in the wrong place. Fascinating stuff, though a presentation which would arguably be better suited to our Spring meeting (groan. Ed).

The Saturday conference was followed by two days of site visits, making or renewing our acquaintance of some subterranean gems in and around Nottingham. When Sub Brit was founded in 1974, many of our founder members lived in Nottingham but our last formal visit was back in 1998 so a return was more than overdue. Paul Sowan has written up the weekend elsewhere in this edition so everyone can share the sites we saw.

Finally, I hope everyone has a relaxing festive season and recharges their batteries (literally and figuratively) ready for 2019 which I am sure will bring new low-spots to us all.

chairman@subbrit.org.uk

*Members admire just a small fraction of the immense Core Store at the British Geological Survey.*

# SUBTERRANEA BRITANNICA DIARY

## Summary of Forthcoming Events

### Sub Brit specific events

#### 2019

12 January Committee Meeting

1 March Copy deadline for *Subterranea* 50

1 April Mail Rail Trip no.3

27 April Spring Meeting & AGM, London

Early May *Subterranea* 50 published

3 - 6 May Berlin Study Weekend

8 June Committee Meeting

13 June Standedge Tunnel Trip

1 July Copy deadline for *Subterranea* 51

5 August Mail Rail Trip no.4

Early September *Subterranea* 51 published

1 November Copy deadline for *Subterranea* 52

Mid-December *Subterranea* 52 published

### Other underground-related events

#### 2019

16 - 24 March Fortress Study Group - Northern France Study Tour

13 April SERIAC Conference, Kent

25 - 29 April Railway & Canal Historical Society AGM Weekend, Barrow-in-Furness

20 - 26 May Hypogea, Bulgaria

4 - 8 July NAMHO Conference 2018, Wales

9 - 14 August AIA Conference, Somerset

13 - 22 September Heritage Open Days, England

21 - 22 September London Open House

September (tbc) Heritage Open Days, Scotland, Wales & N. Ireland

For web links to these events please visit *www.subbrit.org.uk/events*
or contact the organisation concerned

*If you know of other relevant events run by other societies, please let us know so that they can be advertised in the next edition and on the website*

# Minutes of Committee Meeting 19 October 2018 at British Geological Survey (BGS), Nottingham

Sub Brit Secretary, Linda Dixon

**Attendees:** Martin Dixon, Tony Radstone, Linda Dixon, Paul Sowan, Jason Hughes, Chris Gray, Tim Wellburn, Phil Catling, Richard West.

Apologies for absence: Richard Seabrook, Nick Catford, Bob Templeman.

**Health & Safety**

Following the recent incident of two visitors being locked in a bunker after a visit, Martin has written some guidelines which have been published in *Subterranea.* In addition, there have been two formal complaints to Sub Brit to which Martin has responded.

**Grants and Projects**

There are no new applications for grants, although there are several possibilities in the pipeline. We would welcome suggestions from members for worthy projects to award grants.

**Committee Expenses**

The Committee agreed to revise the expenses policy for members to attend Committee Meetings, to ensure that people are not out of pocket on their attendance costs. Attendees are encouraged to use the cheapest reasonable method for travel and share cars where possible.

**Opening Paddock**

Bob Templeman has been arranging guides for Paddock recently, but has given notice that he doesn't wish to continue. Any members wishing to take on (or help out with) this role are asked to contact the Secretary.

**Systems Proposals**

We reiterated our commitment to moving to a rolling membership year; this will make the administration of new members easier. The systems will move from CiviCRM and we will use Eventbrite for booking events.

**Social Media /Instagram**

We continue to get several thousand followers and hope that some of these convert their interest to membership.

**Autumn/Spring Meetings & AGM**

The Autumn Meeting is all set up for tomorrow at the BGS - 68 attendees booked. We are indebted to Andrew Hughes for all the help he has given to Chris, Phil and Linda in arranging this. We will give away old copies of *Subterranea* to reduce our stock holdings.

The Spring Meeting has been booked for 27 April 2019 at the Royal School of Mines, in a new room on the ground floor. Costs have gone up, so we will increase the attendance fee to £23 for pre-booked and £25 on the day. RSM are no longer able to host meetings in term-time, so we will need a new venue for Autumn 2019. Date set as 19 October 2019. Phil will work on Edinburgh for Autumn 2020.

**Visits weekends**

Nottingham is all lined up for this weekend, with 50 booked on visits on Sunday and Monday.

Tony is arranging a weekend in Berlin for 3-6 May 2019; plans are looking good so far.

Phil is looking at an Alderley Edge weekend for later in the summer/autumn.

**Day Visits/Trips**

We've still got a good number of trips being arranged. Recent trips have to been to Cornwall (Chris Kenney) and Paddock. We'd still like offers for more from members!

**Committee Reports**

Nick reports that he would like help in acquiring contributors to *Subterranea* - a Commissioning Editor is required. Tim, Richard West and Chris will help with sub-editing and proofreading the next issue as Linda, Martin and Stewart Wild will be away.

Tony presented a financial review for consideration. It is likely that we will have increased costs for next year including new systems, *Subterranea* costs and expenses. A proposal to increase subscription rates to £25 was agreed. This will be raised at the AGM and, if agreed, be implemented for members who join after that date.

**Thanks**

Many thanks to Andrew Hughes and the BGS for hosting our Committee Meeting and the Autumn Meeting.

# NEWS

## Miscellany compiled by Paul W Sowan and Nick Catford

### NEWS – ARCHAEOLOGY

**Reports published on human remains at Picken's Hole and Scragg's Hole, Compton Bishop, Somerset**

Picken's Hole is a small partially-unroofed natural cave on the south-facing slopes of the Mendip Hills in Somerset. It is named after M J Picken who was, in 1961, investigating the burrowings of badgers and noted that pieces of bone and teeth had been thrown out by the animals. These were submitted to the Bristol City Museum and identified as hyena and woolly rhinoceros. E K Tratman of the University of Bristol Spelaeological Society excavated at the site in the years to 1966 and confirmed the presence of human bones and implements alongside those of the prehistoric animals. A preliminary report was published by the UBSS in 1964. Now over fifty years later the first part of a comprehensive report has been published, as seven papers in the latest issue of the *Transactions of the UBSS.*

*Entrance to Picken's Hole*

These include, *inter alia*, accounts of the human remains and implements at this site. One further paper in the same issue describes material from nearby Scragg's Hole, including prehistoric stone implements and Roman and later artefacts.

SOURCE: ApSIMON, A.M., G.J. MULLAN, and P.L. SMART, 2018, Introduction to the 1960s excavations at Picken's Hole. *Transactions University of Bristol Spelaeological Society* 27, 239-244 [and six other papers], and ROSS, Wendy, and Allen SUMMERFIELD, 2018, Scragg's Hole, Compton Bishop, Somerset. *Ibid*, 343-354.

**Jane Seymour's family home with a network of walk-through sewers discovered in Wiltshire**

The magnificent 16th-century home of the Seymour family, where the Tudor king Henry VIII first showed an interest in his third wife Jane Seymour, fell into ruin within forty years of being built in the Wiltshire village of Burbage. It was eventually lost and nobody today is exactly sure of its location or appearance – but original features of the property have now been uncovered by archaeologists and historians who have proven its true location.

The remarkable findings include the network of Tudor brick-built sewers and some of the foundations of two towers and several large rooms of the palatial home. The team of up to twenty volunteers has spent twenty months on the project.

*Dominic Binney, a descendant of Jane Seymour's family, in the rediscovered Tudor sewers under Wolf Hall*

The Tudor Wolf Hall was built as the seat of the Seymour family in the early 1530s with a loan from Henry VIII – and brokered by Thomas Cromwell. Jane Seymour's brother Edward became the Duke of Somerset and his son, also called Edward, was imprisoned in the Tower by Queen Elizabeth in the 1560s for his clandestine marriage to Lady Catherine Grey and was only allowed to return to court after her death. He abandoned Wolf Hall to build a new manor, Tottenham House, about a mile away. By 1571 Wolf Hall lay derelict and was finally demolished in 1723. Walk-through sewers were unknown until Henry VIII's time and these would have been extremely prestigious at the time they were built; they run for 140 yards in total.

SOURCE: *MailOnline,* 2 October 2018

**A painted tomb with a 2,000-year-old drawing of a banquet uncovered in Italy**

Archaeologists have found the ornately-decorated burial site in Cumae, a ruined city in modern Italy, which was among the first ancient Greek settlements in western Europe. Researchers have been working at the site since 2001. Until now, only tombs painted red or white had been found, but in June 2018 researchers discovered a room with exceptionally executed figure-painting.

A naked servant carrying a jug of wine and a vase is still visible; the banquet's guests are thought to have been painted on the side walls. Other elements of the banquet can also be distinguished. In addition to the excellent state of conservation of the remaining plaster and pigments, such décor in a tomb built in that period is rare; its

'unfashionable' subject matter was in vogue one or two centuries earlier. This discovery is also an opportunity to trace artistic activity over time at the site.

To preserve the fresco, archaeologists removed it, along with fragments found on the ground, in order to reassemble the décor like a puzzle.

SOURCE: Centre national de la recherche scientifique: press release, 25 September 2018

## NEWS – HEALTH & SAFETY

**21 miners killed in China**

Twenty-one miners have been confirmed dead after a rock burst destroyed part of a mining tunnel in east China on 20 October. The tunnel where the miners were working was blocked at both ends by coal after pressure caused rocks to fracture and break, leaving 22 people trapped. The only survivor was found on October 21 - one day after the accident.

The spontaneous fracturing of rock is a kind of earthquake induced by excavation. During the accident, part of a water drainage tunnel was destroyed in the burst and two people were killed by fractured rocks that fell in the tunnel. More than 300 people were working inside the mine at the time of the rock burst, and most were successfully lifted to safety. More than 700 rescuers were sent down the mine and they spent nine days searching for survivors. Rescue operation halted after the body of the last miner was lifted out of the mine.

Deadly mining accidents are common in China, where the industry has a poor safety record, despite efforts to improve coal production conditions and crack down on illegal mines. In December 2016, explosions in two separate coal mines in the Inner Mongolia region and in northeastern Heilongjiang province killed at least 59 people.


Earlier that year, 33 miners were killed in a colliery explosion in October in the southwestern municipality of Chongqing, and in September, at least 18 were killed in a mine blast in the northwestern Ningxia region. According to China's National Coal Mine Safety Administration, the country saw 375 coal mining related deaths in 2017.

SOURCE: *MailOnline,* 29 October 2018

## NEWS – MILITARY AND DEFENCE

**Inscriptions made by American soldiers survive in French quarry tunnels**

America deployed more than one million troops to Europe in WWI, and they were known as 'doughboys' because disparaging European cavalrymen thought the large brass buttons on their uniforms looked like flour dumplings or dough cakes.

Among them were the young men of Boston's 26th Infantry Division who arrived in Saint-Nazaire, France, on September 27, 1917, to support British and French forces and helped hold the Aisne line - the Allied Front beyond Chemin des Dames. The ridge over Chemin des Dames would change hands several times during the course of a series of ultimately fruitless battles. In the second battle of Aisne alone 400,000 troops died in a matter of weeks in early 1917.


When US troops were not on the front line some of them took shelter in a quarried-out cave at Froidmont, where they whiled away the hours by carving their names and 250 military insignia and portraits of themselves and their horses into the stone as they holed up in the quarry which was equipped with artificial light and drinking water.

After the war that cave was preserved and has been a tourist attraction for decades; access is controlled by the local historical association. The only way to enter the quarry is via a ladder through a hole in the ceiling, which is closed with a hatch.

SOURCE: *MailOnline,* 2 November 2018

**Abandoned munitions railway tunnel at Carrickfergus Castle is reopened**

Work has been ongoing since September to open a 'secret Victorian tunnel' into Carrickfergus Castle in County Antrim, on the northern shore of Belfast Lough. The tunnel has been sealed and forgotten about for almost 100 years.

The start to the archaeological excavations of the harbour end of the tunnel is being undertaken to re-establish a second point of entry into the castle. This will facilitate access to the keep by the specialist works teams on the roofing project. It will also help ensure continued public access to the castle at this time.

The tunnel was constructed around 1889, and was originally an underground railway used to bring mines and other munitions from the harbour to the Grand Batteries above. At that time the castle was in military use, as a key defence of Belfast Lough. The tunnel does not appear to have been used for very long, and was closed when the castle came into State care in 1928.

*Photo from Love Heritage NI Facebook site*

Earlier work has also confirmed that there is a substantial depth of rubble infill material in the passage leading from the floor of the tunnel to an earlier ground level which will require careful excavation to ensure that any earlier buried remains continue to be protected. Longer-term, work will be conducted to establish if this tunnel may be accessed by the public, once construction works are complete.

Two modern brick walls and the manholes have now been carefully removed and archaeologists have cleared the tunnel so that it is now open all the way from the harbour into the inner ward. Archaeologists will expose the remainder of the munitions tunnel during November, with building work on the roof of the keep scheduled to begin later in the month.

SOURCE: *Belfast Live*, 3 September 2018 and Love Heritage NI Facebook site

**Cold War bunker complex with open access, easternmost Russia**

A site in easternmost Russia likely to appeal to adventurous Subterranea Britannica Cold War bunker devotees has been described in the cavers' magazine *Descent*.

'A huge amount of military infrastructure remains. The coastline is dotted with derelict structures, and deserted bases lie squirreled away in hidden valleys. In fact, among a cluster of hills only 18 km from Anadyr (Chukotka's capital), you may find a nuclear missile storage and launch facility that is decommissioned and slowly returning to nature.'

Near the town Ugolnye Kopi, in Chukotka province, lies the main base and warhead storage complex and barracks. 'Nearby hills conceal a network of tunnels with power cables, ventilation ducts, maintenance hatchways and a goldmine-esque mini-railway network. All of this is interspersed by rolling blast doors for, in the centre of this excavated webway of access tunnels, sit large, domed chambers. Here, not long ago, dwelt monsters. Not dragons, but … A-bombs.'

Alaska is remarkably close to this end of Russia. From the extreme eastern peninsula, Cape Dezhnev, it is only 86 km to the westernmost end of Alaska's Seward Peninsula. Maybe there is a similar concentration of concrete structures over there? The Russian base is at 64° 46' 43" N and 177° 53' 15" E.

The article includes two aerial images from Google Earth, and four ground-level photographs of buildings and a tunnel entrance.

SOURCE: SOUNESS, Colin, 2018, In Bond's footsteps. *Descent* 255, 36-37.

**Harpenden air-raid shelters filled with concrete following safety concerns**

A structural survey of four underground air-raid shelters in Harpenden (Herts) concluded they were a "catastrophic risk to public safety" under well-used pedestrian routes. There are two under Leyton Green, one by the sensory garden on Bower's Parade, and one under Queens Road.

According to the Harpenden and District Local History Society, excavation work on the Bower's Parade shelter started just nine days before Prime Minister Neville

*Photo Chris Rayner*

Chamberlain declared war with Germany in 1939. It was built in a dog-leg shape, with six 10-yard lengths connected by 90-degree corners, using reinforced concrete for the walls and roof. There were wooden benches and chemical Elsan-type toilets (behind sackcloth modesty screens) for the comfort of 180 people who could fit inside. Further information about the shelters can be found on the Sub Brit web site.www.subbrit.org.uk/db/1446990430.html

Harpenden Town Council wanted to preserve the shelters and had considered opening them for school parties but renovation would have been too costly so the council reluctantly took the decision to fill them in with aerated concrete during September.

In order to save the history, the council has created 3-D scans of the shelters, which will be available to view online. There will also be information boards erected at Leyton Green and Bower's Parade about the shelters and World War II.

SOURCE: *Herts Advertiser*, 17 September 2018

**Tunnel and air-raid shelter in Newcastle open to the public**

Earlier this year, Brinkburn Street Brewery, a local micro-brewery in Newcastle-upon-Tyne, moved to Ford Street in the Ouseburn area, and opened a brewery tap and kitchen. The premises had previously been a timber merchants but in the 19th century had been the site of the decorating and packing departments of the Maling Pottery.

*Photo Phil Thirkell*

The main areas of the pottery were actually on the other side of the road and so a tunnel was constructed so that the pottery could be moved without exposing it to the weather. During WWII it was also used as an air-raid shelter.

The new occupiers are quite amenable to opening up the short tunnel for customers to view. It isn't particularly long - essentially just a little more than the width of the road.

SOURCE: Phil Thirkell

## NEWS – MINING AND QUARRYING

**Government Inspector of Mines visits Reigate 'Caves', Surrey**

An Inspector from the Health & Safety Executive has visited the Reigate 'Caves' and advised the Wealden Cave and Mine Society of changes recommended in that body's operation of its guided public tours underground in the town centre. The Society opens the Barons' Cave (part of the Reigate Castle Scheduled Ancient Monument) and the Tunnel Road East and West 'Caves' on five Saturdays each year.

While the West 'Caves' appear almost certainly to have been primarily a mine for glass sand, the East 'Caves' may have been created, in whole or in part, as beer cellars. The Barons' Cave appears to have been a wine cellar, and part of the Norman castle, so not a mine.

*Tunnel Road West Caves. Photo Nick Catford*

The inspector's most important, and potentially most expensive, recommendations are that provision for emergency exits should be made in the West 'Caves'. Specifically, the World War II access to and from Tunnel Road beyond the north portal should be reinstated, and a new tunnel should be driven from the western area of the mine to the east-west gallery currently used as a rifle range. The exit to Tunnel Road would need the former wooden staircase to be reinstated and the bricked-up door reopened. The new tunnel would probably be dug through the area backfilled in the 1980s around the debris resulting from the major collapse in 1858.

SOURCE: Paul Sowan

**Coal mines in east Kent**

From the 1850s onwards geologists speculated on the possibility of there being exploitable coal seams below southern England, and indeed sums of money were expended on sinking boreholes, especially in Kent, Surrey and Sussex where supplies close to London were hoped for. Much money was wasted in probing the depths of Surrey and Sussex where nothing was found at a workable depth and, in fact, there are no coal seams under those areas anyway.

Success of a kind came near Dover in 1890 when a borehole proved the presence of relatively thin seams at the Folkestone end of Shakespeare Cliff. This first successful investigation was at the abandoned Channel Tunnel site, but of course at a much greater depth than the trial tunnel in the Chalk. A twenty inches-thick seam was found at a depth of 1,180 feet on 15 February 1890.

Below that, six more seams were found at depths down to 2,221 feet, the thickest being four feet.

Over 45 boreholes were then made in east Kent, confirming the presence of coal below an extensive area, and at ten locations full-size shafts were sunk, surface buildings erected, and rail connections laid. Commercial quantities of coal were however not raised until at Snowdown near the Canterbury to Dover railway line in 1912.

Development of the Kent coalfield was expensive and challenging on account of the great depths and quantities of groundwater flooding the shafts during sinking. This required continuous pumping when coal raising commenced at the four sites which eventually became productive mines.

**The four successful mines**

**Betteshanger** (TR 336 528) Coal was proved at a depth of 1,476 feet in a borehole in 1912. Shaft sinking commenced in 1924, and coal production in 1927. There were two shafts 22 feet in diameter with depths of 2,929 feet and 2,438 feet. Closed in 1989, this was the last of the four mines to remain in operation,

**Chislet** (TR 213 629) Shaft sinking commenced in 1914. The north shaft reached coal at 1,350 feet. Closed 1969, so the first mine to close. The mine, served by Chislet Colliery Halt, was beside the railway line from Canterbury to Ramsgate. There is a site plan in Waywell's volume.

**Snowdown** (TR 246 512) Commenced development in 1906 but the first shaft was abandoned on account of flooding. A third shaft reached 360 feet in 1909, and coal was raised from 1913. The Milyard Seam was reached at 3,000 feet in 1917. Output reached 600,000 tons per annum in 1938. Closed in 1988.

*Snowdown Colliery in October 1987*

**Tilmanstone** (TR 287 503) Sinking commenced in 1906. The Milyard Seam was reached in 1917. Closed in 1986. The mine was served by the (now closed) East Kent Railway, to the north of Shepherdswell. There is a site plan in Waywell's volume.

**The six unsuccessful mines**

**Guilford** (TR 280 469) Commenced in 1906. Shafts were sunk to 1,272 feet and 1,269 feet but work was halted by flooding in 1914. Abandoned in 1922.

**Maydensole** (TR 321 461) Commenced in 1910 but no shafts sunk, so abandoned.

**Shakespeare Cliff** (TR 295 393) A first shaft was commenced in 1896 but abandoned in 1897 at a depth of 303 feet as a result of flooding when eight men were drowned. Shafts 2 and 3 reached 1,632 feet in 1914, when work stopped. Twelve tons were raised in 1893 and another 120 tons in 1912. The mine closed in 1915. It is said that more coal was consumed working the engines used to sink the shafts than was ever raised here. The same is no doubt true of the other failed mines.

Proposals to mine a 16-foot bed of ironstone much closer to the surface than the coal came to nothing beyond 2,350 tons raised for testing.

**Stonehall** (TR 271 456) Shaft sinking commenced in 1913 but was abandoned at 273 feet in 1914. The enterprise was finally abandoned in 1921.

**Wingham** (TR 254 569) Shafts were started in 1910 but abandoned at 50 feet, and the enterprise was finally abandoned in 1922.

**Woodnesborough** (**Hammill**) (TR 293 557) Started in 1910 but abandoned in 1914.

SOURCE: WAYWELL, Robin, 2016, *Industrial railways and locomotives of Kent.* Melton Mowbray: Industrial Railway Society: 458pp [ISBN 9781-901556-92-6] £35.

**Underground quarry at Portland, Dorset, could become part of new Eden project**

A revolutionary 'Eden Project' on Portland which will bring £24m to the local economy and create more than 130 jobs is set to become reality with formal plans set to be submitted by the end of the year. The development brings together the visions of two world-class attraction projects that had been planned for Portland for some time – MEMO and Jurassica which will bring 325,000 visitors to the area every year.

Once opened, the attraction will form part of a wider vision for a global network of sites by Eden Project International, an off-shoot of the Eden Project, who are developing new Edens in the UK and around the world including China, Australia, New Zealand and the USA.

In partnership with the Eden Project, the visitor destination will transform and regenerate exhausted quarry and mine workings within the tunnels of Albion Stone's Jordans Mine and accessed from Bower's Quarry on Portland to create an extraordinary subterranean visitor experience dedicated to biodiversity. While the

name is still to be decided, the new attraction is being developed with both local and regional partners including Dorset LEP, Weymouth and Portland Borough Council, philanthropist Sue Lyons, and The Valentine Trust.

Under the new proposals, there will be nearly a linear kilometre of underground 'gallery' space with a labyrinth of tunnels allowing visitors to explore the dramatic history of life on earth. Using circus, drama, artworks, games, virtual reality and the ancient art of stone carving, visitors will explore the improbability that there is life at all, its evolution, the ancient stories written in the rocks of the Jurassic Coast, the current crisis of modern biodiversity loss, and the variety of possible futures ahead of us.

A design team has now been appointed, including international award-winning virtual reality and visual effects artists.

SOURCE: *Dorset Echo,* 3 September 2018

**Lead and zinc mines at Nenthead, Cumbria**

Nenthead, one of the highest settlements in England, is a bleak and lonely place, a few miles east of Alston. It was a creation of the defunct lead and zinc mining industry, and the main attraction for visitors is the extensive area of mining buildings and structures, and (for the more adventurous) at least four still-accessible mines.

The mining area is now Scheduled as an Ancient Monument, and local management overseen by the voluntary Nenthead Mines Conservation Trust. A former visitor centre which members of Subterranea Britannica may remember visiting has, sadly, closed, although the Trust maintains a bunkhouse (with a kitchen and washing facilities) where mine explorers can stay overnight.

*Underground waterwheel in the Nentforce level at the base of Brewery Shaft in Rampgill Mine. Photo Nick Catford*

There are four main accessible mines and part of one (Carr's Mine) can be visited by guided underground tours open to the public at specified dates and times. The remainder of Carr's Mine, and Capelcleugh, Rampgill and Smallcleugh mines are for more serious and suitably experienced and equipped groups with competent and locally knowledgeable leaders. Some routes underground are quite suitable for properly led beginners, whereas others are decidedly wet (shoulder-depth water in places, for example), technically challenging, not to say hazardous for those unfamiliar with abandoned deep metal mines.

A very good overview of what is to be seen underground, easily or otherwise, has been published in the cited source.

SOURCE: NIGHTINGALE, Helen, 2018, Nenthead lead mines. *Newsletter Chelsea Spelaeological Society* 60 (1/2/3), 4-8 [includes nine underground photographs]

**A new robot system will reopen abandoned, flooded mines**

The idea of underwater mining is not restricted to the ocean floor (see article). High water tables submerge many terrestrial deposits, too. At minimum, this means doing a lot of pumping to make them workable. Sometimes it makes those deposits altogether inaccessible. Flooding also adds to the cost of reopening closed mines. The team behind VAMOS hopes to do something about this.

The Viable Alternative Mine Operating System, to give its full name, is being developed by a consortium of 16 European firms and research institutes. It is currently on trial at Silvermines, Ireland, which, as its name suggests, was once home to workings for silver and other metals. They are now closed and flooded. But one of them, a source of baryte, the principal ore of barium, has been repurposed as VAMOS's test bed.

The core of VAMOS is a pair of remotely controlled vehicles. These are floated on board a special platform into place over the site to be mined, and then dropped through the water (to a depth of 57 metres in this case) by a crane.

The larger vehicle is a 25-tonne tracked robot with a powerful rock-cutting head at one end and, at the other, a hydraulic gantry that can carry tools such as drills and grabs. Crushed ore-bearing rock is pumped to the surface through a flexible pipe, and a cable carries power and data between the robot and an onshore control centre.

The smaller vehicle is called EVA. It has neutral buoyancy and swims around the mining site. It was designed at the Institute for Systems and Computer Engineering, Technology and Science, in Portugal. EVA first makes, and then continually updates, a 3-D map of the area - transmitting this cartography to the main vehicle, to assist navigation.

Both vehicles use sonar, cameras and laser rangefinders to work out where they are. They send these data to a pilot in the control centre, who sees them displayed on a multi-screen console of the sort gamers can only fantasise about. A future version may also be able to analyse the ore spectroscopically as it is mined, enabling rich seams to be pursued and poor ones abandoned.

SOURCE: *The Economist,* 8 November 2018

**Croesor and Rhosydd underground slate quarries, North Wales**

Croesor and Rhosydd are two large underground slate quarries near Blaenau Ffestiniog in North Wales. They are connected underground by a single tunnel made, it is reported, to settle a territorial dispute between adjoining quarry operators.

*The underground link between Croesor and Rhosydd*

Both quarries consist of very large mined-out caverns flooded at the lower levels, linked by steep inclines and horizontal connecting tunnels. The through trip, entering by Croesor and exiting via Rhosydd, described in the cited source calls for caving equipment experience and skills, and is not for the faint-hearted. Huge voids are crossed by flimsy bridges or installed zip-wires and at one point by canoe, and vertical ascents and descents are made by SRT (single-rope technique).

SOURCE: DEWSNAP, Richard, 2017, Croesor-Rhosydd. *Newsletter Chelsea Spelaeological Society* 59 (10/11/12), 68-73 [includes nine photographs]

**Drilling starts at the UK's first deep geothermal electricity plant, Cornwall**

Drilling started in November at what could become the UK's first deep geothermal electricity plant in Cornwall. Two wells will be drilled through hot granite rock near St Day, the deepest of which will reach 2.8 miles deep and could power 3,000 homes.

The firm running the project, Geothermal Engineering, says the aim is to demonstrate the potential of geothermal technology to produce electricity and renewable heat in the UK. It is believed that the plant at the United Downs Industrial Estate has the potential to supply up to 3MW of electricity.

Once drilling at the site is complete, water will be pumped from the deepest well at a temperature of approximately 190C. This water will be fed through a heat exchanger at the surface and re-injected into the ground to pick up more heat from the rocks in a continuous cycle. The extracted heat will be converted into electricity and supplied to the National Grid.

Geothermal technology is described as a 'continuous' energy source because it does not suffer from peaks and troughs experienced by other sustainable power sources. Developers hope the technology used at the facility could be used in other locations in Cornwall and Devon.

SOURCE: *MailOnline*, 6 November 2018

**Llanberis Copper Mine East, North Wales**

This colourful mine has an easily found entrance at the top of a steep and mobile scree slope of mine waste. A roomy entrance passage leads to a vertical pitch beyond a stretch of false floor (under which timber-work bridges a void) so caution is called for. Below the descent one lands on a second false floor. There follows a third pitch, a 30-metre drop. Fourth and fifth pitches follow. The lowest accessible level is flooded thigh-deep, the water covering a further shaft in the floor.

Exploration of the passage at this level is made more interesting by the presence of further holes in the floor which are visible when first encountered and crossed, but invisible on the return on account of the minewater being stirred up with sediment. So, despite the accessible and inviting entrance, not a visit for beginners who lack SRT equipment and expertise, or lacking awareness of the need to recognise false floors and flooded shafts.

SOURCE: VOYSEY, Mandy, 2017, Llanberis Copper Mine East. *Newsletter Chelsea Spelaeological Society* 59 (10/11/12), 74-75.

**Most privately-owned Spanish coal mines to close by the end of 2018**

Spain is to shut down most of its private coal mines by the end of the year after government and unions struck a deal that will mean €250m will be invested in mining regions over the next decade.

Pedro Sánchez's new left-wing administration which

took power in June has moved quickly on environmental policy, abolishing a controversial 'sunshine tax' on the solar industry, and announcing the launch of Spain's long-delayed national climate plan next month. Unions hailed the mining deal – which covers Spain's privately owned pits – as a model agreement. It mixes early retirement schemes for miners over 48 with environmental restoration work in pit communities and reskilling schemes for cutting-edge green industries.

More than a thousand miners and subcontractors will lose their jobs when 10 pits close by the end of the year. Almost all of the sites were uneconomic concerns that the European commission had allowed Spain to temporarily keep open with a €2.1bn state-aid plan.

Spain's coal industry employed more than 100,000 miners in the 1960s, but its energy dominance was eroded by cheap imports and increasing awareness of the industry's environmental, health and climate costs. National coal provides just 2.3% of Spain's electricity.

SOURCE: *The Guardian,* 26 October 2018

**Cwmorthin underground slate quarry, North Wales**

This extensive underground slate quarry is used by commercially led groups of would-be explorers, as well as visited by experienced cavers. A survey is available but incomplete. The lowest level is flooded. Fixed aids are to be found such as bridges over chasms, zip wires, and caving ladders.

SOURCE: FAWCETT, Adrian, 2017, Cwmorthin Mine. *Newsletter Chelsea Spelaeological Society* 59 (10/11/12), page 76.

**Open Day at Betteshanger Sustainable Parks**

An open day took took place on 3 November as the £40million Betteshanger Sustainable Parks on the site of the former colliery edges closer to its grand opening on 30 March 2019. Local residents were updated on progress at the 121-hectare site which included a hard hat tour of the building site giving them a glimpse of the facilities to come. They also had the opportunity to speak to the team about plans for the Kent Mining Museum, which has been designed to celebrate and preserve Kent's coal mining heritage, plus membership and volunteering opportunities.

*Betteshanger Colliery after closure. Photo Nick Catford*

Once complete, the site will include a visitor centre encompassing the Kent Mining Museum, walking trails and outdoor play equipment. Demolition of the old café and visitor centre, cycle hire and park office began immediately after the open day.

Betteshanger Colliery opened in 1924-30 and closed in 1989.

SOURCE: *KentOnline* 18 October 2018

**Pillar and stall mining for tungsten, China**

Room and pillar, or pillar and stall mining, usually of more or less horizontal beds of sedimentary chalk, coal, gypsum, rock-salt stone etc, is a long-established extraction technique in mining and in quarrying underground for building-stone. It was certainly used in the Chaldon and Merstham quarries by the Middle Ages, for example.

Characteristically, 75% of the mineral is removed, leaving 25% in-situ to support the mine ceiling and superincumbent strata. The other 25% could be retrieved by opencast working, at the cost of removing and disposing of the overburden. The 25 / 75 proportion was presumably arrived at by trial and error.

A technical account of modern pillar and stall mining describes a tungsten mine developed from 1993 in Jiansi Province in China, where the lateral extent of extraction has reached 5.3 square kilometres. On account, presumably, of the relatively high value of the mineral and wish to maximise the extraction ratio, elaborate calculations taking account of factors such as rock properties and joint patterns and spacing have been used to calculate optimum floor-ceiling heights and tunnel and pillar widths. For a tunnel height of five metres, tunnel widths of up to 12 metres and pillar widths of 5.5 metres were arrived at.

SOURCE: ZHANG, Youfeng, and Ni PENGPENG, 2018, Design optimization of room and pillar mines: a case study of the Xianglushan tungsten mine. *Quarterly Journal of Engineering Geology and Hydrogeology* 51 (3), pp.352-364.

**Another underground cannabis farm found in Wiltshire**

Police raided Bethel Quarry near Bradford-on-Avon on 27 September and found a large cannabis factory inside. They executed a warrant under the Misuse of Drugs Act at the quarry and underground they found the factory.

Two beds were found inside, and two Albanians were arrested. The size of the project is yet to be fully determined but sources say the farm could dwarf the previous biggest, found 26 miles away at the former Chilmark nuclear bunker last year.

Bethel Quarry started its life in the hands of the Bath and Portland Stone Company but when quarrying finished it was put to a new use by the Agaric Mushroom company as a mushroom farm. With its constant temperature and dark conditions it is the perfect location for mushroom growth. The quarry is fairly small with one single adit which is on a slight incline as the quarry is on a gradient and the floor level gradually increases throughout.

In 1939 the War Department requisitioned the quarry, carried out some strengthening work and used the space to store naval anti-aircraft parts, radio direction-finding equipment and optical equipment during the Second World War. After the war, the quarry was handed back to the mushroom company. This was because the roof level was too low in places making it unsuitable for military use, plus nearby Copenacre Quarry was big enough for the Royal Navy's storage needs by this time.

The quarry was soon put back to use as a mushroom farm, and farming continued on a large scale under the new name of Oakfield Farm Products Ltd until the 1990s. The mushroom farm was visited by members of Subterranea Britannica around this time. The quarry tunnels were sold in 2011 and advertised as being supplied with electricity and water.

SOURCE: *Metro,* 28 September 2018, and Higgypop website

## NEWS – MISCELLANOUS

**Possible Luddite's bolt hole discovered in Loughborough (from the archives)**

Secret tunnels and an underground room have been discovered at the former home of one of Loughborough's most famous residents - John Heathcoat. This discovery adds weight to the theory that one of Loughborough's most hated men was living in fear of his life.

Heathcoat had many enemies in Loughborough and Nottingham causing one of the most violent and destructive Luddite episodes 190 years ago. Heathcoat had made a machine capable of reproducing the best handmade pillow lace, putting many lace makers' livelihoods at risk and crippling the competition by extracting large sums of money in royalties. He also cut the wages of his own workers.

Fuming with anger, a group named The Luddites stormed the pubs of Loughborough, blackening their faces and spreading their fury. They attacked Heathcoat's mill, wrecking 55 lace-making machines and shooting one of the factory guards.

Heathcoat modified his house, the present 38 Leicester Road, in anticipation of being the next on the Luddites' hit list. The present discovery is of a small subterranean room, measuring 6ft 3ins by 4ft 3ins and a mere 6ft 5ins high – small enough for one man to hide in if under attack.

*The subterranean room*

Access was by a tiny trapdoor hidden under the floorboards and also by a secret curving tunnel from the cellar, with an entrance no bigger than a dog kennel. The secret room is lined with bricks and has an arched roof. The tunnel, however, is a rough construction and could have been built at a later date giving an alternative access to the secret room.

While Heathcoat fled to Devon before the Luddites could seek his blood, the house stands as a testament to the memory of a man driven out of Loughborough by those who despised the progress his machines had made.

SOURCE: *Loughborough Echo,* 11 August 2006

**Property developer wants to convert underground Oxford toilets into holiday apartments**

Planning proposals have been submitted to Oxford City Council which, if approved, could see a number of the city's underground public toilets transformed into apartments for tourists and visitors to the city.

The proposals as submitted look at the below-ground men's public toilets on St Giles, which were built in 1895, later undergoing a £47,000 refurbishment in the 1980s. They were closed by the Council in 2008 after over 100 years due to health and safety concerns about their position in the middle of St Giles.

The lease was put up for sale a few years ago, with a guide price of £65,000, and was bought by Oxford-based hotelier Harries-Jones Limited. Planning permission was previously granted for conversion to offices, but the Local Democracy Reporting Service has stated that the new proposals would provide for two units each with a two-person capacity.

Harries-Jones says that it hoped to install large glass canopies above the current entrances to the toilets as well as restore the railing present at the moment. With the location being situated between Oxford landmarks such as the Ashmolean and the Martyrs Memorial, they are confident that the location will be in high demand with tourists. They are looking to rent the units out for periods of up to a week.

Some concerns were raised about the air quality inside these subterranean apartments, but architect Edward Gillibrand addressed these by explaining that there would be a plant room which would generate clean air to be supplied to these rooms. It is thought this system will avoid any unpleasant smells during the busy city-centre rush hours.

The initial proposals have been given approval by Oxford Civic Society. Oxford Preservation Trust however still maintains some apprehension about the glass canopies.

SOURCE: *The Oxford Student,* 11 August 2018

**Beer storage back in the 'caves' at Reigate, Surrey**

There are numerous man-made underground spaces excavated into the Folkestone Sand in and around the town centre at Reigate. They range from rock-cut shop cellars to quite impressive abandoned glass-sand mines. Historically, some of the mines, once abandoned as sources of sand, found secondary uses including the ageing and storage of beer made at the former town-centre brewery of Mellersh & Neale.

*The wine vaults in Tunnel Road East. Photo Nick Catford*

The Wealden Cave and Mine Society has access to some of these spaces, and has entered into an agreement with the small local Pilgrim Brewery to store six whisky barrels of 'Imperial Stout' to mature underground in one of the 'caves', in fact the rock-cut wine vaults currently accessed via the Tunnel Road East 'Caves'.

SOURCE: ANON, 2018, Beer underground. *Descent* 262, page 7.

**Foxenden Quarry air-raid shelter in Guildford could be used for whisky storage**

Guildford Council is considering an enquiry from an unnamed company that is said to be interested in using the Foxenden quarry shelter tunnels to store whisky while it matures. The company would require a lease of 25-30 years.

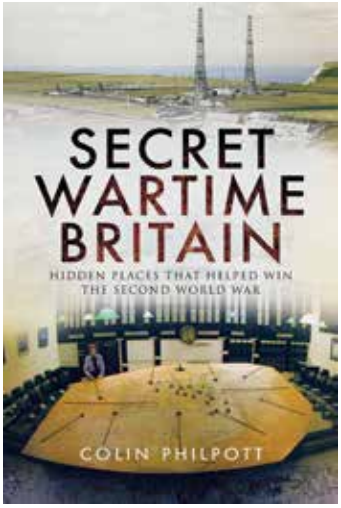
The Foxenden Deep Shelter was built to accommodate 1,000 people during WWII but was closed to the public in 2010 with occasional flooding and bad electrics among the reasons why it was considered unsafe. Furthermore, the shelter was gifted to the Council as a charitable trust

*Photo Nick Catford*

with covenants stating it must not be used for the sale, production or consumption of alcohol. These covenants can be changed but only after permission has been sought and after a lengthy consultation.

SOURCE : Nick Catford

## NEWS – PUBLICATIONS




***Secret Wartime Britain: Hidden Places That Helped Win the Second World War***

PHILPOTT, Colin, 2018: Pen & Sword: 247pp [ISBN 9781-52673-8] £25.

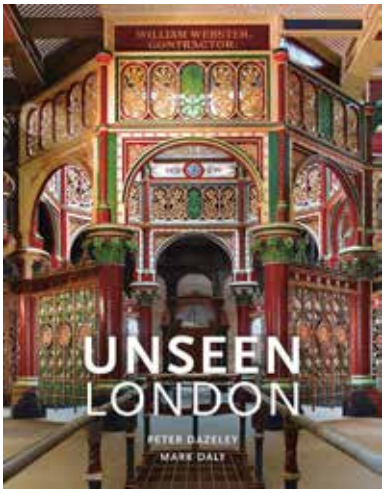
During the Second World War, thousands of sites across Britain were requisitioned to support the war effort. Additionally countless others were built from scratch regardless of cost. Often the purpose of these locations was concealed even from those living close by.

The author of *Secret Wartime Britain* has compiled a fascinating collection of examples that still exist today, albeit often in different usage. They include underground factories, storage sites and headquarters; spy and communication centres; interrogation and POW camps; dummy sites; research facilities such as sinister Porton Down; treasure stores in stately homes and even royal retreats in the event of invasion such as Madresfield Court. Where were these sites and why were they needed? How successfully were they kept secret? What has happened to

them since? Were they returned to their owners? Answers to these and other questions make *Secret Wartime Britain* a riveting and revealing read.

The book covers a large number of underground and semi-underground sites including Chain Home Radar, Royal Ordnance Factories, aircraft factories, Battle of Britain Operations Rooms, Paddock, military command centres, storage facilities, Auxiliary Units, and Rhydymwyn. It is well illustrated throughout, although unfortunately the quality of the illustrations is generally poor and some are very dark and lacking in detail.

***Unseen London***




DALY, Mark (author) and DAZELEY, Peter (photographer), 2017: Frances Lincoln: 272pp [ISBN 9780-71123-9074] £32.

From Tower Bridge to Battersea Power Station, Big Ben to the Old Bailey, the author takes readers on a tour of the hidden interiors of some of London's most iconic buildings. Celebrated photographer Peter Dazeley takes you deep into the boiler room of the city's infrastructure, into the changing rooms of our greatest temples of sport, into the heart of the Establishment, and behind the scenes at the most opulent buildings in the Square Mile.

Photographs of these extraordinary buildings – some derelict, but many still working – are accompanied by the story of how each of these places was created, how they are used, and what they reveal about the currents of power flowing through the city. See a glimpse of London behind closed doors with this unique guide to the city's buildings, revised and updated for 2018 to include the royal palaces of Hampton Court, the Tower of London and the Inigo Jones Banqueting Hall at the Palace of Whitehall, and the Royal Courts of Justice, Supreme Court and Bow Street Magistrates Court.

Underground sites included are Paddock, Aldwych station and underground parts of other buildings. The book is profusely and superbly illustrated. Peter Dazeley is a fellow of the Royal Photographic Society and was recognised for his services to photography in the New Year's Honours list in 2017.

## NEWS – TUNNELS & TUNNELLING

**Collapse of an 18th-century culvert leads to road closure in Shropshire**

A 19th-century underground culvert, thought to have been commissioned by the Duke of Sutherland, has been discovered after part of a road collapsed in the village of Church Aston, Shropshire. The brick-built tunnel was found under the road after a five-foot-wide hole opened up. It is estimated the culvert, which could date back to the 1800s, stretches over 1.5 miles and is thought to have been used to supply water to Longford Pools for use in large-scale farming activities as a direct result of the draining of Kynnersley marshes. However, a local historian claims it was more likely to have been built by another wealthy family to supply water to an ornamental pool.

*Church Aston culvert*

The culvert was found after a section of road collapsed at the junction of Greenvale and Dark Lane in Church Aston, and has closed the road to traffic since the start of October. A well-type structure was uncovered underneath the carriageway at the junction, which sits on top of an old brick-built culvert that connects to a sandstone tunnel. Engineers are now investigating the best solution to repair the culvert.

SOURCE: *BBC News Shropshire,* 2 November 2018

**Tunnelling below the Cathedral at Winchester, Hampshire**

On 17 March 2018 a plaque was unveiled at 118 Portland Road, South Norwood (London Borough of Croydon), the former residence of William Robert Walker [1864-1918], the celebrated 'Winchester Diver' who famously saved the Cathedral from collapse, and a memorial service commemorating the centenary of his death was held in the city on 6 October 2018.

Winchester, a former capital of England and the last resting place of the jumbled bones of half a dozen or so Saxon kings, lies on the river Itchen flanked to the east by chalk hills. A Saxon minster was erected in the mid-seventh century close to the site of an even older Roman forum on the west side of the diminutive river.

After the Conquest of England by the French from Normandy the building was pulled down and replaced by a very much larger Romanesque cathedral on approximately the same site. This new structure had been extended eastwards by the fourteenth century, making

Winchester (even after part of the west end collapsed in twelfth century) the longest cathedral in Europe.

By 1905 the eastern extension was showing alarming signs of possibly imminent collapse. As a result investigations were instigated into what lies under the foundations of this very large building. The retrochoir at the east end had been built on a layer of peat overlying river gravel below which is chalk. Unfortunately the foundations here were resting on the bed of waterlogged peat. The extensive crypt has always been subject to groundwater flooding every winter, and still is. For this reason the crypt has never been put to any use.

The investigations revealed that the peat substratum, not the groundwater, was the problem. The solution was to extend the foundations downwards into the gravel which was better able to take the weight of the huge stone building.

Architects and engineers were consulted, and William Walker, a professional diver whose work hitherto had mostly been concerned with underwater structures in docks and harbours including Gibraltar and in flooded coal and lead mines, was engaged for the next five years to excavate the peat from underneath the building and replace it with cement, cement blocks, and brickwork.

Walker excavated a total of 235 tunnels three or four feet wide and up to 24 feet long under the retrochoir, digging out the peat and emplacing the new load-bearing foundations in complete darkness and under a depth of 13 feet of muddy water. He worked by feel alone: an electric lamp would have been of little use in the muddy water.

From April 1906 to November 1911 his working week was of two four-hour shifts each day. Three hours of each shift were spent in complete darkness underwater. He had, of course, a support team at the surface responsible for the air supply to his diving suit, and for lifting out excavated material and lowering materials. For completing this heroic task and halting the partial collapse of the historic structure he was made a Member of the Victorian Order. Sadly he died aged 54 as a result of the flu epidemic in November 1918.

A visit to Winchester Cathedral, a very large building constructed mostly of Quarr stone from the Isle of Wight, prompts speculation on the nature of the quarry or quarries from which it came. Quarr stone is a (geologically) young limestone, supplies of which were apparently exhausted some centuries ago. Whether the quarry was opencast or underground is not clear.

Historically, building-stone for cathedrals in southern England was quarried underground. Salisbury is Chilmark stone, mined nearby in Wiltshire. Canterbury is Caen stone imported from Normandy and Reigate stone from Surrey, while Westminster is or was also Reigate stone.

SOURCE: HENDERSON, Ian T., and John CROOK, 1984, *The Winchester Diver: the saving of a great cathedral.* Henderson & Stirk, Publishers: 128pp [ISBN 0-9506549-8-1]

**German company wins contract to supply new trains for London Underground**

A £2.5billion contract for new trains on the London Underground will go to Siemens after a High Court ruling on 2 November. The ruling opened the way for London Underground Ltd to award the contract to Siemens Mobility Ltd, the British subsidiary of German firm Siemens.

Under the deal, Siemens will make, supply and maintain 94 new trains to replace rolling stock on the Piccadilly line, which dates back to the 1970s. TfL has previously said the contract will lead to a new factory being built in Goole, east Yorkshire, employing around 700 people.

Siemens will have options to supply a further fifty trains on the Bakerloo and Waterloo & City lines, and the contract, which is due to last forty years, is said to be worth up to £2.5billion. The ruling is a setback for Derby-based train maker, Bombardier Transportation UK Ltd, who tendered for the contract in a joint venture with Hitachi Rail Europe Ltd. Bombardier, Hitachi and Alstom Transport UK Limited, which also put in an unsuccessful bid, say that the tendering process was fundamentally flawed.

SOURCE: *MailOnline*, 2 November 2018

**Secret tunnels, sunken boats and graffiti dating back to 1756 are discovered at Blenheim Palace**

Archaeologists have found secret tunnels, sunken boats and graffiti dating back to 1756 inside Vanbrugh Bridge at Blenheim Palace, the birthplace and ancestral home of Sir

Winston Churchill. They have also uncovered evidence that the windowless rooms may have once been lived in by people in the early 18th century, while one of the chambers has an original plastered ceiling and evidence of a cooking range.

The 33 rooms were built within the 400ft-long bridge when it was constructed on the grounds of the estate in Oxfordshire by John Vanbrugh in 1708. It was not until 60 years later they became flooded after celebrated landscape gardener Capability Brown had a 40-acre lake dug around it.

The lake has recently been drained for the first time to allow 400,000 tonnes of silt and sludge to be dredged from it. It means archaeologists and historians have been able to access many of the mysterious rooms for the first time. Access is from a manhole cover that drops down to one part of the bridge and a small door at the foot of it that takes you up a spiral staircase.

SOURCE: *MailOnline*, 30 October 2018

**Volunteers stabilise south portal of Berwick Tunnel on the Shrewsbury Canal**

Volunteers have been working on the north portal of Berwick canal tunnel near Shrewsbury as part of a plan to restore a section of canal as a tourist destination and ultimately to reopen the tunnel itself – currently the entrances are bricked up. While doing so one group noticed that the southern portal had become very overgrown, with a danger that the roots and invasive growth would damage the structure, which is listed as being of historic and architectural interest.

Such was the urgency to protect this portal that a decision was made to delay the ongoing work at the north portal and concentrate efforts and clear the stonework and stabilise the sandstone southern portal.

Members of the Shrewsbury Canal Rewatering Group had to clear 400 metres of towpath and one accommodation bridge of 40 years' neglect to enable volunteers to reach this portal in order to deliver tools and materials to the site. The volunteers, using only hand tools, slowly cleared away the huge amounts of ivy, shrubs and small trees which were taking over the sandstone fascia. The work was slow and undertaken with great care because of the importance of protecting the stonework from any damage.

The long-term plan in place is to operate this section

of canal as a tourist destination to fund its permanent protection for future generations. Berwick Tunnel was completed in 1797 and originally built for tub boats to transport coal from Oakengates to Shrewsbury. It was the first canal tunnel of any size to accommodate a towpath - which was later removed.

One interesting feature of the tunnel is that it has an S-bend in the middle, a result of the navvy constructors not quite lining up during the original building work, causing a dog-leg which must have caused difficulty for narrowboats over the years.

SOURCE: *Shropshire Star*, 2 November 2018

**Consultation begins on £6.8bn tunnel under the Thames**

Plans for a new six-lane toll tunnel under the Thames that will almost double the amount of traffic that can cross the river east of London were unveiled on 10 October. The new £6.8billion Lower Thames Crossing will be expanded from a four-lane to six-lane highway and at 2.4 miles long will be Britain's longest road tunnel, according to the latest proposals. Highways England have begun a 10-week public consultation over the plans, and said they hoped the road could be operational by 2025.

The tunnel will almost double the amount of traffic able to cross the Thames east of London, Highways England have claimed. Motorists will pay a toll to use the new tunnel but the level of the toll has not yet been decided, although a Highways England source confirmed it was their aim that any charge would be 'affordable'.

This will be the first new crossing of the river east of London since Dartford's Queen Elizabeth II bridge opened in 1991. The only existing route for motorists is the Dartford Crossing, which consists of the bridge and two tunnels. It is used for fifty million journeys annually and is often the scene of frustration for motorists stuck in traffic jams for several hours following accidents. The new crossing is expected to reduce traffic at Dartford by 22 percent.

SOURCE: *MailOnline,* 10 October 2018

**The world's longest sea crossing opens in China**

The world's longest sea-crossing bridge connecting Hong Kong and Macau to Zhuhai, southeast China finally opened in late October. Construction started in 2009 on the Hong Kong–Zhuhai–Macau Bridge (HZMB).

This is a 34-mile bridge–tunnel system consisting of a series of three cable-stayed bridges, an undersea tunnel, and four artificial islands. It is both the longest sea crossing and the longest fixed link on earth. The HZMB spans the Lingding and Jiuzhou channels, connecting Hong Kong, Macau, and Zhuhai, the three major cities on the Pearl River Delta.

*The tunnel section of the Hong Kong-Zhuhai-Macao bridge was completed on 7 July 2017, marking the end of construction of the main structure for the world's longest and deepest underwater tunnel*

The HZMB was designed to last for 120 years and built at a cost of (US$18.77 billion). The cost of constructing the Main Bridge was estimated at US$7.56 billion funded by bank loans and shared among the governments of mainland China, Hong Kong and Macau.

Originally set to be opened to traffic in late 2016, the structure was completed on 6 February 2018 and journalists were subsequently given rides over the bridge. On 24 October 2018, the HZMB was opened to the public after its inauguration a day earlier by Xi Jinping, General Secretary of the Communist Party of China and President of the People's Republic of China

SOURCE: Various press and Wikipedia

**Proposal to link Windsor's two stations, Berkshire**

A former submarine scientist has entered the race to build Britain's first privately-funded railway. George Bathurst wants to connect the train lines running through Windsor by building a new stretch of tunnel under the Royal Berkshire town.

Windsor's two stations remain unconnected since they were built in 1849, despite being only 300 metres apart. The £370million link would improve connections for people living in the M3 and M4 corridors, opening up a new direct route from Slough through to London Waterloo. A second phase, costing around £1billion, would create direct rail links to Heathrow from the west and south of the airport, amid plans for a third runway.

Bathurst believes the scheme would be the first new rail line to be fully privately funded since the railways were nationalised in 1948.

SOURCE: *MailOnline*, 18 August 2018

**Abandoned Sydney underground station platforms to become bars, restaurants and shops**

The proposal, announced by the New South Wales Government at the beginning of October, will breathe new life into the forgotten network. The tunnels and platforms at St James Station will rival a similar scheme in New York once a 6,000-square metre space has been remodelled, Transport Minister Andrew Constance told Fairfax.

St James Station is a heritage-listed underground commuter station that is located on the City Circle, at the northern end of Hyde Park in the Sydney central business district. It provides a direct link to the Sydney Airport international and domestic railway stations.

St James Station was opened in 1926 and was originally intended to be a major interchange with the Eastern Suburbs line. Plans for the construction of St James included railway lines in four directions, but the original plan was never completed due to disagreements over the routes.

Four platforms were completed, but the two inner platforms, intended to support Bradfield's proposed eastern and western suburbs lines, were never put into service. When the Eastern Suburbs line was eventually built it was done via a different route. In the 1990s, the two island platforms were connected by filling in the space between the two inner platforms, resulting in the single, large island platforms in use today

*Photo Ben Knight*

From 1933 - 1934, the unused tunnel between St James and Circular Quay was used as the location for an experimental mushroom farm. During World War II the tunnels were modified to serve as a public air-raid shelter. The abandoned air-raid shelter begins in the double-track tunnel section at the north end of the station and continues into the two single-track tunnels beyond.

In recent years the Australian Railway Historical Society has given tours of the tunnels, but many people have visited the tunnels by walking along the subway tracks.

The government is on the hunt for people to help transform the tunnels beneath Hyde Park and through the Cahill Expressway entrance off Macquarie Street. The proposal is hoped to be finalised in 12 months.

SOURCE: *MailOnline*, 1 October 2018 and Wikipedia

**Battle over rail tunnels at Lord's cricket ground rumbles on**

A dispute over a narrow strip of land at the edge of the historic Lord's cricket ground in north London has been rumbling on for nearly twenty years. The stretch of land,

measuring 656ft by 125ft at the Nursery (eastern) End of the Lord's site, sits above disused Victorian railway tunnels. That area has been at the heart of a tussle between the ground's owners – Marylebone Cricket Club (MCC) – and the owner of the lease on that strip of land, property developer Charles Rifkind.

After being frustrated over the past two decades by the MCC in his plans to develop the site, Mr Rifkind has teamed up with property consortium New Commonwealth to look at selling off portions of the land. Mr Rifkind has had lots of interest, particularly from the Indian subcontinent, who see Lord's as a special place in their hearts. Although the MCC does not own the tunnels, or any development rights to the land on top, it does have a sub-lease on the top 18 inches of the land – which runs until 2137. That makes property development impossible for another 119 years at the earliest.

*The photograph shows the construction work in progress. The tunnels were built by cut-and-cover. When finished, the area was covered over and the new cricket pitch laid. Photo from Leicestershire County Council Records Office*

The drama began on 9 November 1999, when Railtrack told the MCC that the main lease on the strip of land above the 1890s tunnels would be sold at a public auction a month later. It also invited the club to make a pre-auction offer for this main lease. But negotiations in the month leading up to the deadline were unsuccessful, and the land and a 999-year lease were bought at auction by Mr Rifkind for £2,350,000 - above what the MCC said it could afford.

The tunnels have been visited by Sub Brit members on two occasions. In 1996 the Wellington Hospital to the north of Lord's cricket ground wanted to extend their basement car park and during exploratory work they broke into one of the abandoned tunnels. As the contractors did not know exactly what they had found, Subterranea Britannica was contacted in March 1997 and asked to investigate the tunnel.

In 2014 Sub Brit was invited back to visit the tunnels by Charles Rifkind. The only access is through the basement of the Wellington Hospital. See *Subterranea* 35 (April 2014), *What Would Thomas Lord Say?*, pp53-56.

SOURCE: *BBC News Business*, 8 August 2018

**Public tours of underground salad farm in Clapham Common deep shelter**

For the first time (and for a limited time), Growing Underground is opening the Clapham Common deep shelter to give public tours of the world's first underground farm. Visitors will be guided round the tunnels by one of the farm's co-founders.

It's an opportunity to discover the fascinating history of the WWII tunnels, how the farm came to be and its future role in a sustainable world. Visitors will be invited to take home the freshest micro herb salad in town, picked straight off the farm.

The farm is located in one of ten (two were not completed) deep level air-raid shelters built below existing tube stations to protect thousands of London's citizens during the intense bombing by the German Luftwaffe during World War II. Since the end of the war, some of these massive, subterranean spaces have found other uses, including being converted into hydroponic farms by forward-thinking entrepreneurs.

Launched by Richard Ballard and Steven Dring of Zero Carbon Food, Growing Underground is one such project and urban farm brand that has transformed one of these abandoned tunnels into a fully-functioning hydroponic farm producing fresh greens.

After obtaining nearly £1 million in funding from crowdsourced and private investment, Zero Carbon Food leased the shelter in 2014; now the company's carbon-neutral farm can produce anywhere from 5,000 kgs to 20,000 kgs of crops per year, depending on the species. The farm specializes in growing small salad greens with a short growth cycle like pea shoots, Thai basil, mizuna, coriander, mustard leaf, rocket, radish and garlic chive.

In this carefully controlled automated environment that uses energy-efficient LEDs, 70 percent less water and no pesticides, there are a lot of savings and profits to be had, with the company estimating that these crops can bring in an annual revenue of well over £1 million.

The tours run on Tuesdays and Thursdays at 18.00hrs until 7 February 2019 and last approx 75 minutes. The cost of a tour is £45 (40.56 with concession). Tours can be booked through Eventbrite on https://bit.ly/2AZS5fU

SOURCE: Growing Underground website

**Stockport dungeon reopens to public**

Stockport Heritage Trust were pleased to announce the re-opening of Stockport Dungeon and Court Leet to the public recently. The sandstone-cut cells were used to hold criminals from the fifteenth century until the new Magistrates Court at Warren Street was opened. The dungeon cells have been inaccessible for a number of years but will now be open free to the public on the second Saturday of each month. Currently owned by Guinness Housing, the building was converted into a shop in the late 1700s with fresh produce stored in the old cells.

The cells and dungeon will hold new displays on crime and punishment in Stockport, with recreations of a scold's bridle and the gibbeted remains of a local murderer.

https://stockportheritagetrust.co.uk/dungeon/

SOURCE: Phil Catling

*Photo Phil Catling*

SUBTERRANEA BRITANNICA

# 2019 Study Weekend Berlin

BERLIN

## Friday 3 – Monday 6 May 2019

Our European study weekend for Spring 2019 is being arranged by Tony Radstone in and around Berlin. The main activity will fill Saturday 4 and Sunday 5 May but we plan to arrange optional visits on Friday afternoon and during Monday for those who are able to arrive early and leave later. Of course there are many public attractions in the city to make an extended stay attractive.

The focus of the weekend will be on underground sites related to transportation and 20th-century conflict. We are working with local groups such as *Berliner Unterwelten* to finalise the itinerary and plan to include:

Tempelhof (former) Airport [Friday afternoon]
U-Bahn system
Abandoned 'Germania' Tunnels beneath Tiergarten
WWII and Cold War Civilian Air-raid Shelters
WWII and Cold War Communication and Control Bunkers
Military Command Bunkers of Zossen Wünsdorf [Monday]

**Cost**

Our estimate for the cost of the weekend is approximately £340, to include Friday, Saturday and Sunday nights B&B, lunches & dinners on Saturday & Sunday, entrances & guide fees, brief site notes, public and coach transport around Berlin. The hotel single supplement will be about £80.

We plan to stay at the Motel One Berlin Hauptbahnhof, Invalidenstraße 54, 10557 Berlin.

Note that the Motel One has single and double rooms but not twins. Those attending the weekend and not requiring accommodation will save around £150. Extra nights at the hotel should be booked direct with them.

**Travel to Berlin**

You will be responsible for your own travel to and from Berlin but please do not book this until you have a confirmed Sub Brit place. You should plan to arrive in Berlin no later than Friday evening so that the visits can start promptly on Saturday morning. We expect the optional Monday visit to return to central Berlin around 1630 with drops at Schönefeld Airport around 1530 and Tegel Airport around 1700.

**Reservations**

Booking for the weekend will open in January on a date that will be communicated by email. A non-returnable deposit of £50 will be taken at this time.

All attendees must be members of Sub Brit for insurance purposes. Members under the age of 18 must be accompanied by a parent or guardian. You will need to have a good level of fitness in order to participate in the weekend. General conditions for Sub Brit weekends are at: www.subbrit.org.uk/docs/tripcond.pdf

# A visit to two North Cornwall Coastal Mines

Chris Kenney

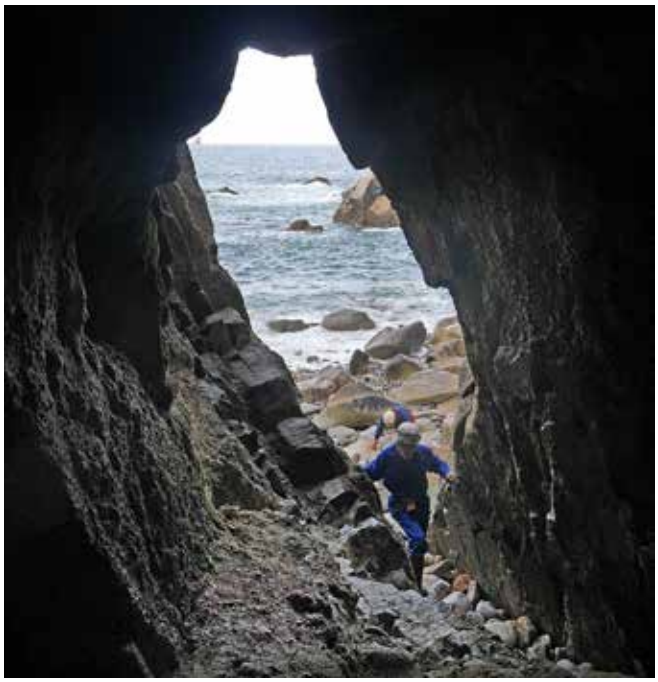
*Heavily timbered stope in Cligga mine. Photo Ed Waters*

## Day One: Cligga tungsten mine

On a sunny Saturday morning in mid-September an intrepid small group of SubBritters assembled on the clifftop at the spectacular Cligga Head, Cornwall. We were met by a group of local cavers who knew the mine and would act as our guides.

The cars were parked as close as we could take them on a rough road at the end of the runway at the disused WWII air station, RAF St Agnes. Our purpose was to descend the cliff path and enter the lower adit into the disused Cligga tungsten mine.

The clifftop still has the Contact Shaft (sealed) and is surrounded by various concrete foundations for the shaft head buildings, and one large Buddle. Nobel once had an explosive works which ceased in 1909, located in the region of the mine buildings site. The mine has been worked at various times but was reopened in 1938 following the formation of a new company called Cligga Wolfram and Tin Mines Ltd. Rich ore veins were found and the Rhodesian Mines Trust Ltd took over the company the following year. Contact Shaft was deepened almost to sea level.



*Looking out to sea from the lower Cligga adit. Photo Chris Kenny*

Two men's names set into the pithead building's foundations, dated 1941, can still be seen. There is a photograph in existence of a man being winched down the now-sealed shaft on a seat suspended from a tripod-like device. This must have been to the top level of the mine which we did not visit as it was described by our guide as "not very interesting".

Following the end of the war, shipments of cheap tungsten began arriving from the United States and the high cost of small-scale mining at Cligga could no longer be justified, and production ceased. In the early 1960s the Geevor Mining Company took out a lease on Cligga with a view to possible reopening.

Contact Shaft was deepened to 500 feet and exploratory drives were started both inland and out to sea. Water was quickly encountered inland but the seaward drive appeared more promising. However results remained inconclusive and Geevor abandoned further exploration at Cligga moving their operations to Levant which they decided to de-water.

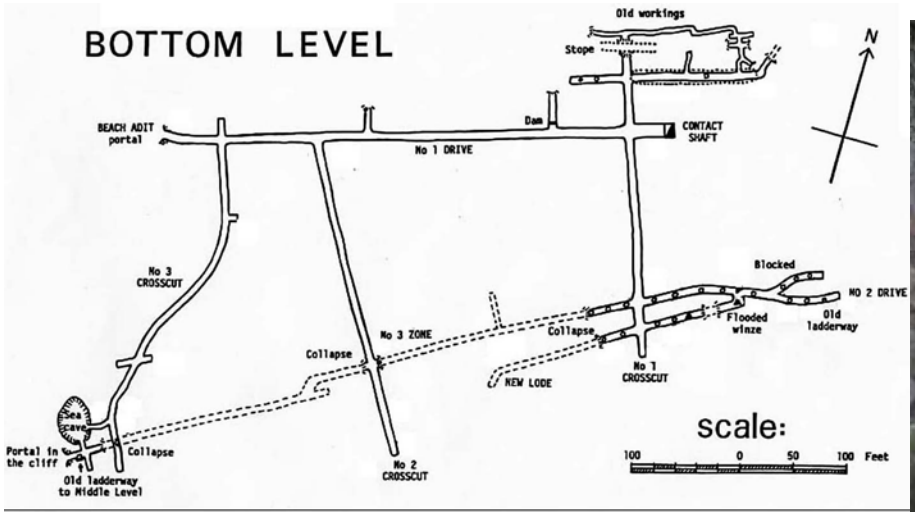
In 1976 tin mining on a small scale at Cligga was considerd by Wheal Concord with limited evaluation being carried out. In 1984 they proposed reopening Contact Shaft but their plans and any further chance of tin production at Cligga were scuppered in October 1985 following the collapse of the tin market.

## Don't look down

The cliff path descent onto the rock-strewn beach beneath the cliff is best described as "interesting". Good advice is to concentrate on where you are putting your feet, take a handhold if there is one and don't look down. I can promise you one thing though, it's a lot further down to the beach than it looks in the photographs.

Those are not pebbles but largish rocks. A close examination of the cliff face shows many artificial openings and fissures, some with signs of tracks to them. I wouldn't, though, attempt the descent in wet weather. The lower entry adit, which is a short climb upwards from the rocks on the beach, is wet in places and wellington boots are required as the route is best described as a slosh.

A short step up in the sea cave entrance leads into the adit proper. A few yards inside we took a detour to the right, along which an ominous periodic roaring could be heard. The noise turned out to be the sound of waves reverberating in a sea cave which has been intersected by the mine level which enters the cave about 15-20 feet above the floor. There is a fine view of the sea so long as sufficient care is taken to avoid plunging into the cave below. There was an old ladderway from the middle level down to the sea cave but there was no access to this from our position.



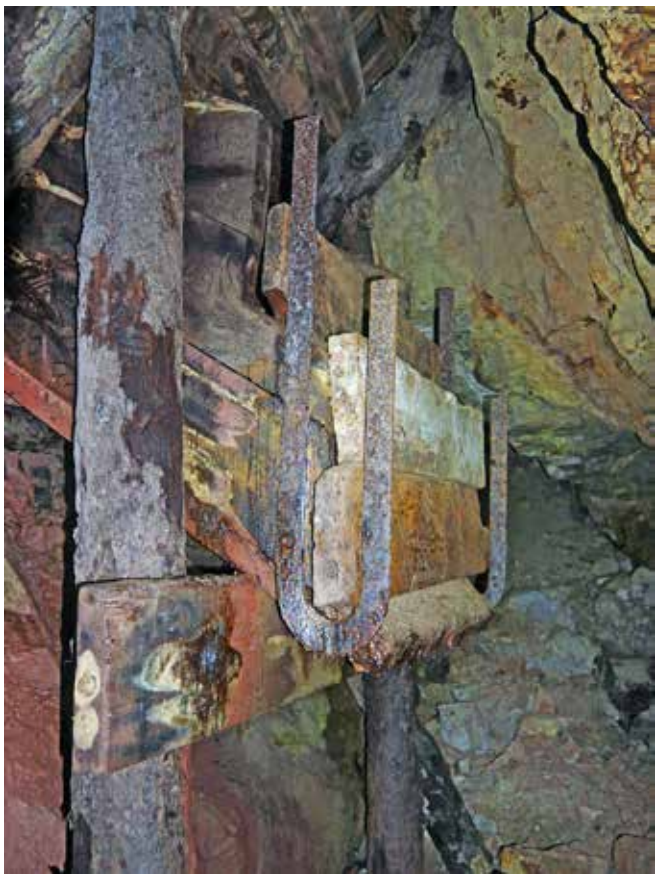

*The party is seen in the Cligga stopes. Photo Ed Waters*

*Contact shaft; the shaft is flooded below the lower adit level. Photo Ken Geddes*

Returning to the main bottom level adit we headed straight ahead to the bottom of Contact Shaft, the capped top of which had been pointed out to us at the top of the cliff. The shaft is apparently 500 feet deep but is flooded to within a few feet of the bottom level.

A few yards back from Contact Shaft a side passage was taken which leads into a huge stope which soars to impressive heights above. At the end of the stope a fixed wooden ladder leads up a short distance to the middle level. On this level we saw some superb ore chutes and eventually arrived at Contact Shaft which disappeared into blackness both above and below us.

Away from the shaft we saw some impressive timbered stopes prior to heading out to daylight via the middle level adit, the entrance being a low crawl which opens dramatically onto the precipitous cliff path way above the beach below. The climb back up the cliff path even caused the younger cavers amongst us to puff a little and we were all happy when we were again amongst the surface building ruins.



*Ore chutes in Cligga. Both photos Ed Waters*

We spent around three hours underground exploring various drives, tunnels, stopes and drifts. All capital equipment has long been removed, but a few bits of drainpipe and cable plus some air-ducting are still to be seen.

Cligga has been much visited and mine charts are to be found on the web, as are photographs by various past explorers. I saw no noticeable traces of minerals in the mine, with the exception of some copper staining in the tunnel walls and a large heap of worked tungsten ore that was left behind when the mine closed.

*The lower adit at Cligga. Photo Chris Kenny*

Cligga, apart from falling down the cliff, is, I believe, one of the safer coastal mines to be visited, but you do need to know what you are about before going into such places, and to be aware of the tide.

Much information on the mine can be found on YouTube: one clip is of a drone flying over the cliffs at Cligga Head, another a video within the mine.

### Day Two: Tywarnhayle copper mine

This mine is found via a small picturesque twisting Cornish lane from Mount Hawke down to the seaside village of Porthtowan. As you drive down the lane you are greeted by the sight of the Wheal Ellen Engine house to your left, exceptional in that it has a castellated top to its chimney.

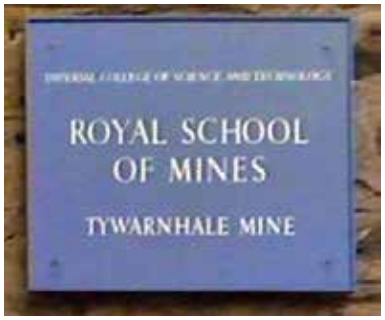
Porthtowan is on Cornwall's north Atlantic coast, about a mile west of St Agnes and nine miles southwest of Newquay in the Cornwall and West Devon Mining Landscape, a World Heritage Site.

At this point I should mention that it is said that the Cornish word *Wheal* when applied to mines translates to English as "place of work," the Cornish for mine being *Bal.* Tywarnhayle mine has had various names. It was worked from 1750 as Wheal Rock then in 1809 became United Hills Mine. On 3 February 1830 an engine boiler exploded and killed nine people. The name Tywarnhayle dates from around 1848. It remained an important source of copper ore until about 1860.

*Taylor's shaft at Tywarnhayle c1907. The newly installed electric pumps are seen*

As you go down the lane you are presented with a high, long hill, that runs parallel on the right of the road. Towards the end of the hill stands an engine house which, 'I believe', belongs to Taylor's shaft. Taylor's engine was part of the Tywarnhayle mine.

Tywarnhayle was a copper mine which was worked for many years. It had the distinction of being the first Cornish mine to be pumped by centrifugal electric pumps made by Worthington Simpson, these having been lowered down the shafts. This was in 1906 when money was invested to drain and re-work Tywarnhayle mine. Water was piped out at the rate of 1,000 gallons per minute. Tywarnhayle also had the world's first commercial froth flotation plant, used when re-working dumps for copper in 1906. This innovation had a worldwide impact on mineral processing. The total amount of copper ore mined between 1826 and 1906 was 86,800 tons. From 1907, when the mine closed, it was used as Royal School of Mines' (part of Imperial College, London) training mine, specialising in surveying and timber preservation. The 42 acre mine site was sold by Imperial College in 2005 to a company which makes organic skincare products who intended using it as its headquarters. The site is designated as a site of special scientific interest and some of the buildings are Grade II listed.




What I understand to be the concrete remains of the generator house can be seen set into the bottom of the hill just above the road. I am not at liberty to describe either the entrance or exit we used to this mine in any detail. This is because if any explorers were to read our journal, enter the mine and a serious accident were to occur, the entrances would be permanently sealed by the authorities.

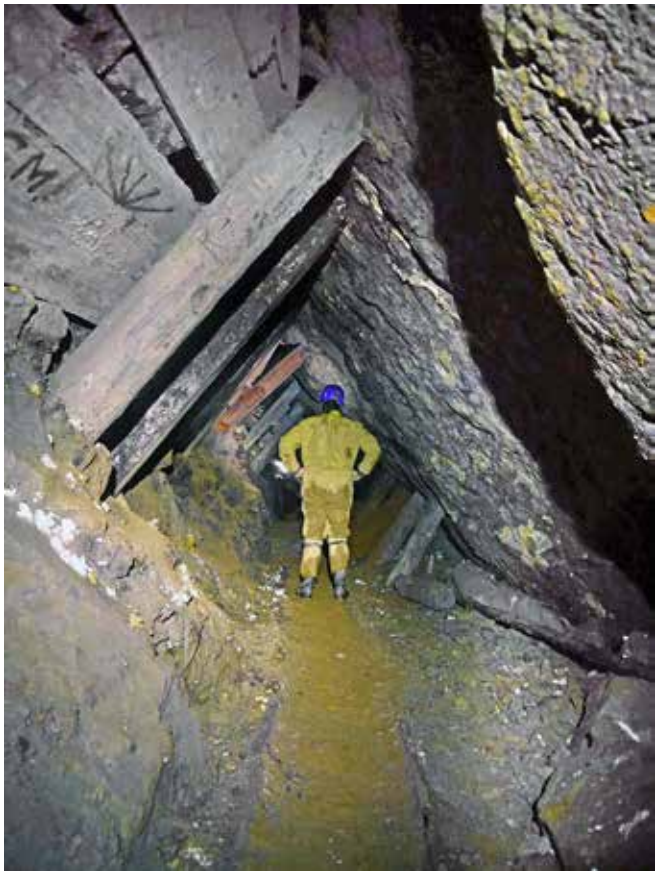
Suffice it to say that after a scramble up the lower slopes of the hill we entered via a small tunnel set into the hillside. The mine is indeed labyrinthine and much more interesting than Cligga, also drier.

We walked onwards scrambling over heaps, over roof falls, and one occasion had to turn back to use another route. We viewed various ore chutes that are still in place. We also had to edge along the side of a large chamber and then slide down a steep bank to a lower level. Above the bank was a fault-line sloping roof supported by ageing wooden props.

At the bottom of the fault decline was a small exit tunnel cut into the rock wall in the chamber's base. It was about this time that our leader Dave explained that we were

*An awkward traverse in the stope led down to a lower level close to the entrance. Photo Ed Waters*

in the old part of the mine, which was considered too dangerous for the Royal School of Mines to use for the students.



*Heavy timbering in the stope ensured a safe route was maintained. Photo Ed Waters*

Going through the small chamber-base tunnel, and after a walk, we came to what is possibly a main shaft. This I assume is in the newer part of the mine. The shaft was cut rectangular and was flooded beneath our level, so presumably any lower levels are also flooded.

We then clambered onwards through a number of other tunnels with branches at various angles from them, some of which have the remains of ore chutes in place and rails for the mine skips, eventually arriving at another near-vertical shaft that was not flooded. This also was rectangular, large and cut at an angle of around 20 degrees from the vertical, ascending from our level.

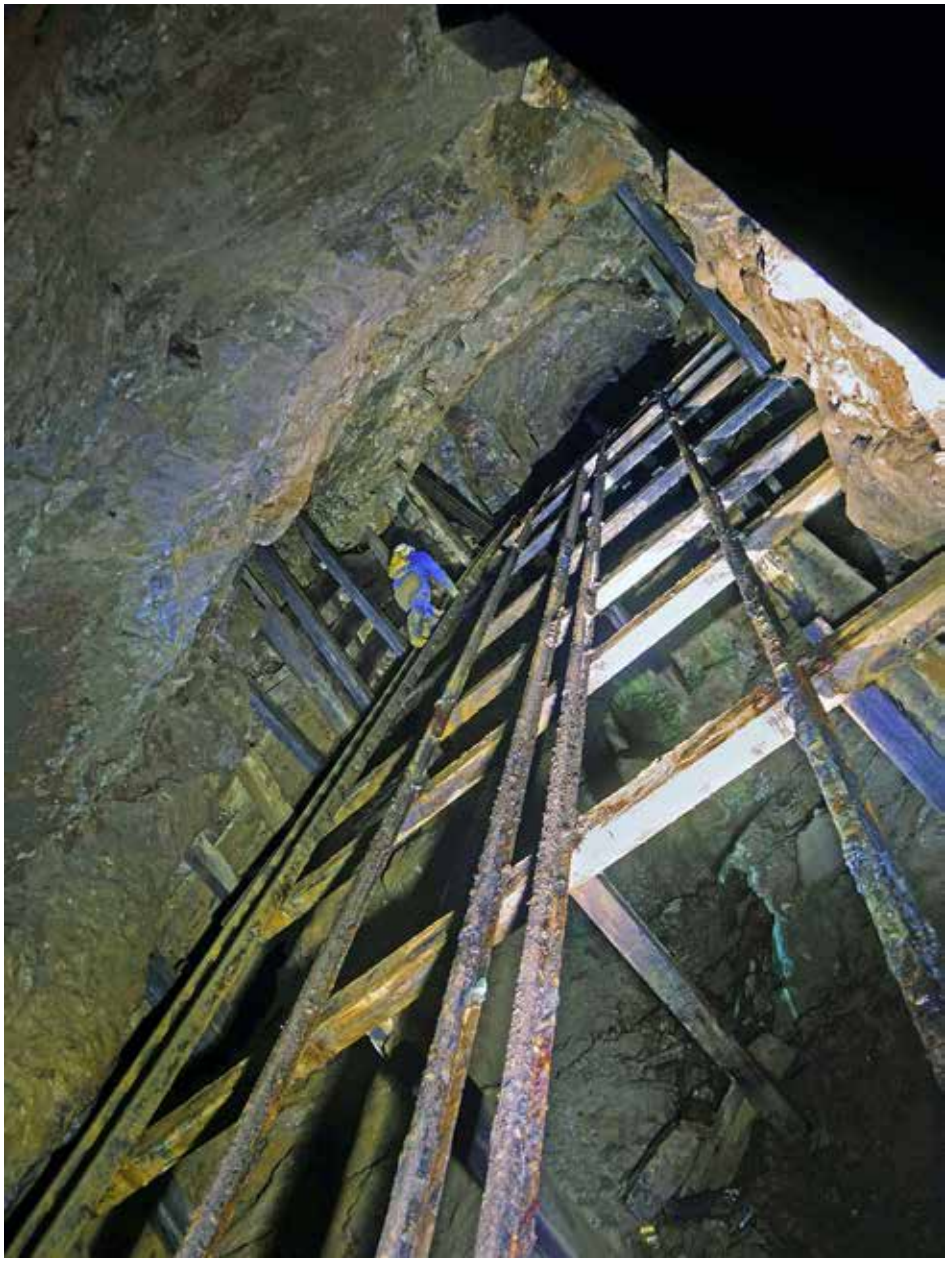
*Tywarnhayle is a very colourful mine; here one member of the party is examining some iron oxide formations. Photo Ed Waters*

Rails ascended the shaft on the opposite side from the chamber we were standing in and a ladder was fitted to big solid wood beams that ascended vertically. I assume that a cage or skips were drawn up and down on the rails and that the vertical wooden beams provided rubbing guides. Looking upwards we could see a wooden platform (obviously installed at a later date) with a hatch door in it high above us.

## Up, up and away

Our leader Dave said, “we climb up”. The metal round rungs on the ladder are around eleven inches apart and set into the stout wooden near-vertical beams. As the shaft is not exactly vertical you climb the ladder as a goat climbs a very steep incline, a cross between climbing and being on all fours. We ascended one at a time for safety reasons, in part because the ladder may not have been able to take the weight of more than one person, but also because if someone were to fall they would knock off the ladder anyone beneath them.

There are around 150 rungs on this ladder before you reach the wooden platform. Once through the hatch you then see another ladder similar to the first, with yet another platform high above. You then climb another 150 or so rungs and you emerge onto a second platform. Then there is a third short ladder of around 15 rungs.



*The long climb up to daylight. Photo Ed Waters*

We then passed along a short twisting passageway, found daylight appearing before us, then it's out through a small wooden doorway and you are near the summit of the hill, but on the other side to where you entered.

The hilltop is a barren mining landscape with remnants of concrete foundations associated with mining and a surface that is obviously waste spread from the mining over the centuries. Little vegetation grows. I assume this is because of contamination by various minerals in the surface spoil.

It was contamination in mine wastes that, when used as aggregate to make concrete blocks, resulted in the infamous Mundic Concrete Blocks. This is a concrete that breaks down when used in building construction and destroys the value of the property. I am told that once a property is declared Mundic, it is very difficult to secure a mortgage to purchase it.

We crossed the hill, descended down a scree slope, which was red in colour, slipping and sliding and returned to our vehicles via a road by some sewerage filter beds.

Before descending the hill, we also inspected a sealed rectangular shaft on the top of the hill that had a newish metal fabricated hinged cover, whose lock had been smashed. This is believed to be James Shaft and is the head of the flooded shaft we had seen underground. If anyone decided to open the cover, climb down and slipped, the fall would be between 300 and 500ft and no doubt fatal.

We had been underground for around three hours and emerged covered in red dust and aching in places in which I did not realise it was possible to ache.

I have to say to all those who may read this that Tywarnhayle is not for the inexperienced. It would be easy to get lost within its workings and parts of the mine must be considered extremely dangerous. This mine should only be visited under the guidance of experienced persons who know the ropes.

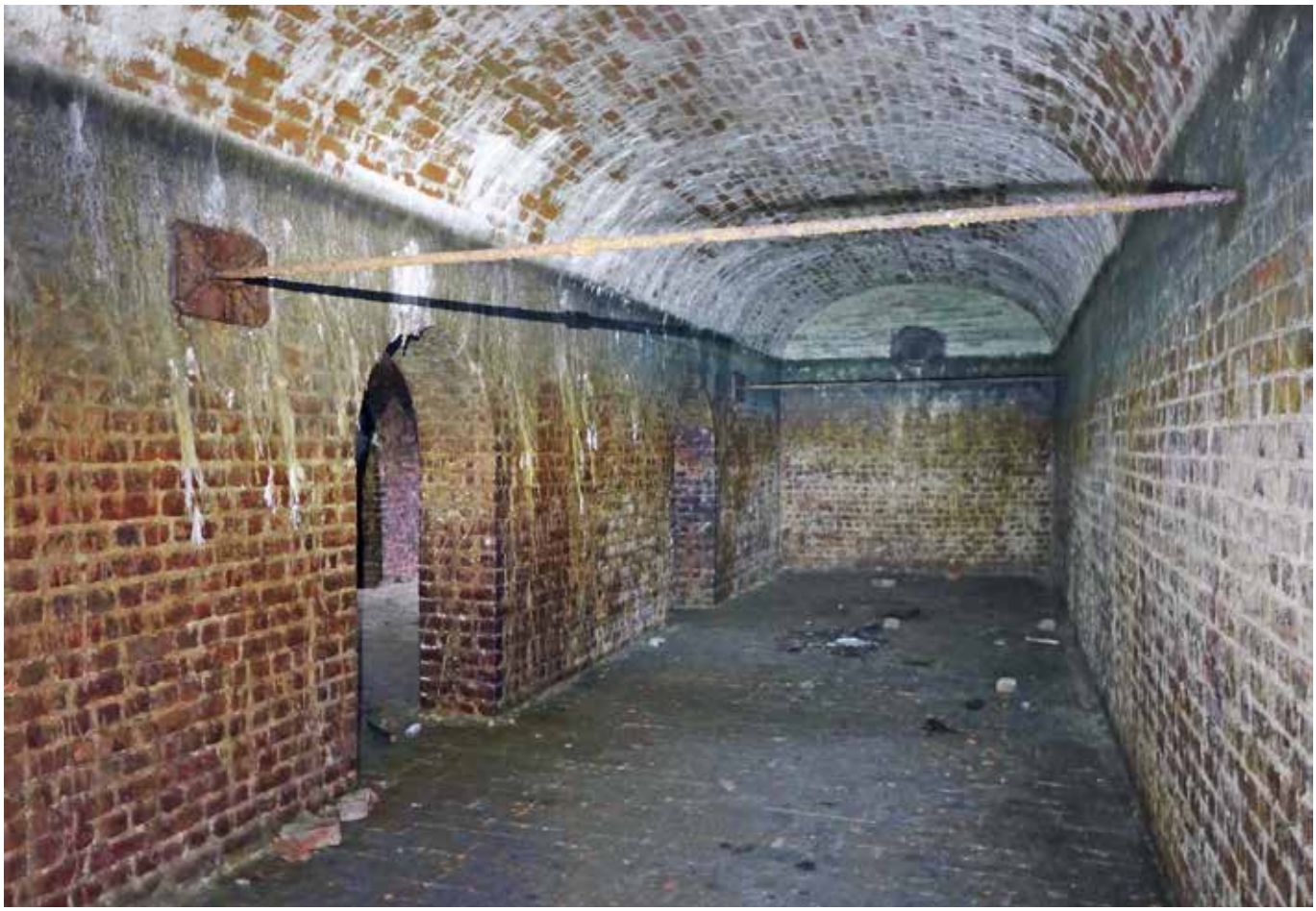
My grateful thanks to Dave Warne, Darren Neale and Simon for giving up their time to guide us on these visits. My apologies to any Cornish cavers who know these sites and their history far better than I.

Photos: Ken Geddes & Chris Kenney.

*A hand line is used to help the climb up one of the large stopes. Photo Ed Waters*

# A Day Out in Lincolnshire: Grantham Underground Reservoir & RAF North Witham

**Tim Wellburn**



*The Grantham Water Company's 1885 reservoir: the far end of the first of four parallel chambers, each approximately 40 yards long. The adjacent chamber is visible through one of the series of inter-connecting archways*

In April 2018, Chris Gray organised a private day-trip, on his home territory of Lincolnshire, for a small group of friends and enthusiasts. Our exploration may be of some interest to *Subterranea* readers.

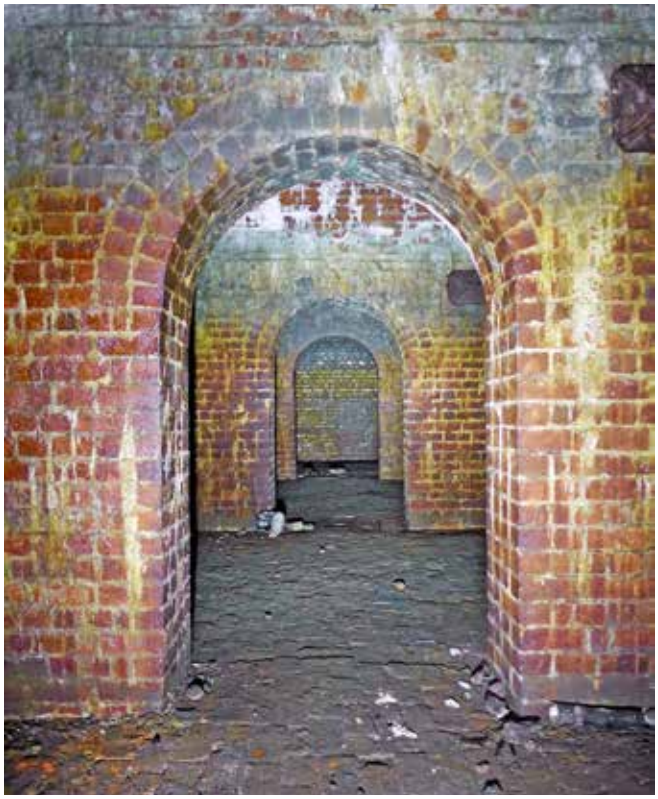
## Grantham Underground Reservoir

Chris kindly met two of us who had elected to travel by train; others had driven and used the station as a reporting point for the small convoy that then set off for Grantham Underground Reservoir. This long-disused reservoir is situated to the southwest of the town, atop what passes locally for a hill, to allow for gravity supply. Whilst lying immediately alongside a road, it is now obscured in thick undergrowth and most people must be oblivious of its existence.

The supply of drinking water, both in terms of quantity and quality, seems to have been a long-running problem in Lincolnshire. Much of Lincoln's water was drawn from the River Witham, and even in 1885, one Dr Harrison had warned about the pollution of this source from agriculture and industry. Complacency and inaction led to typhoid breaking out in Lincoln as late as 1904.

Whether Grantham, sited on the River Witham, was similarly afflicted - or merely a contributor to Lincoln's plight – is unclear. The reservoir we were to visit was built in 1885 by the Grantham Water Company and continued in use until the 1950s when a much larger storage facility was built nearby, now operated by Anglian Water.

*Grantham Reservoir: part of the length of the furthest chamber; note the repointed side wall*



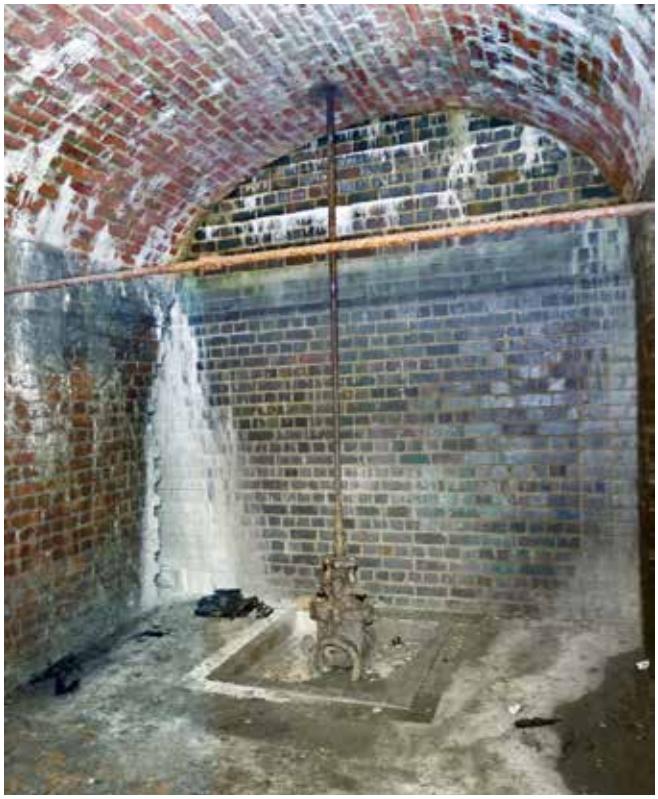
*One set of inter-connecting archways, looking across all four chambers*

The reservoir is a cut-and-cover, semi-underground structure, and we had to scale a steep 6ft bank to reach its top. This was facilitated by Chris's quasi-portable ladder. We negotiated the vegetation – and various cast-iron vent pipes – to reach the far end of the reservoir.

From the evidence of sections of detached masonry, this end seemed to have been rebuilt at some time. This was more clearly evident within, the original end wall having been replaced by one built of blue engineering brick, to which the severed ends of some of the red-brick longitudinal walls were not even tied.

Entry into the reservoir was achieved through a manhole and down a steep fixed ladder, leading into one end of a long brick-built chamber with a low-arched brick roof. This is one of four similar, parallel chambers, interconnected by a series of archways. Each chamber measures about 10ft across; I failed to pace out their length, although this must have been over forty yards. From floor to the apex of the ceiling is approximately 11ft. The longitudinal walls, which are about 8ft high are braced laterally by a series of iron tie-bars and plates, affixed just below the spring line of the vaulted roof.

In the corner of the first chamber, a 4"- 5" diameter pipe, set in the side wall just below floor level, is surmounted by a rusted valve with a long vertical operating spindle running up through an aperture in the ceiling. One of the middle chambers has a similar pipe and valve, set slightly off-centre in the end wall. This also has a vertical spindle reaching through the roof. From their position, these pipes may have been for draining the reservoir rather than for normal supply.



*The rebuilt end wall and drainage (?) valve and spindle in one of the middle chambers*

The far end of the second chamber exhibits three more pipes set at various heights within its end wall. The largest of these (with a diameter of approximately 12") has a butterfly valve within it. These pipes may have been the inlet and outlet supply. Behind this end wall is a 5ft deep brick-lined pit, accessible from the surface, presumably related to the pipe valves. A large, rough-edged hole in the brickwork just below roof level has been broken through from this pit. This is now barred.

*The second chamber with supply pipes (?) in the end wall; the first chamber is to the right*

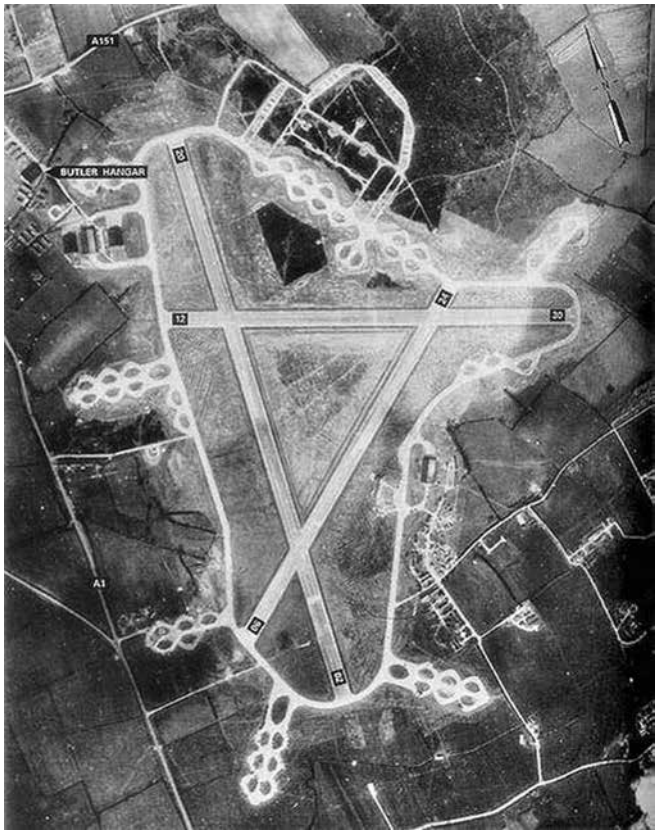
A large rectangular excavation in the floor of the furthermost chamber remains an enigma. This is surrounded by its rubble and obviously post-dates the reservoir's use. It serves to show that the floor is just three bricks deep. Uniquely, the entire side wall of this chamber had also been repointed, quite brutally, at some time.

## RAF North Witham

From the reservoir we travelled on to Twyford Wood, a Forestry Commission plantation of oak and conifers that now covers much of what was once RAF North Witham. Here we paused to eat our picnic lunches before setting off on a sylvan walk in search of remaining concrete.

Built relatively late in the War, to the Air Ministry's Class A Bomber specification (a triangle of three runways, with two T2 hangars), North Witham was intended as an RAF bomber station for No.7 Group. Instead, it became operational, in December 1943, as Station 479 of the US Ninth Air Force, housing IX Troop Carrier Command (TCC).

Its main role was as 1st Tactical Air Depot, repairing and maintaining the fleet of C47 *Skytrain* and C53 *Skytrooper* aircraft required to support the Normandy invasion. To this end, six American 'Butler' hangars were added to the T2s. The airfield also accommodated GC-4 *Waco* assault gliders.




*RAF North Witham, 19 March 1944. Aerial Photograph, Royal Ordnance Survey*

In March 1944 IX TCC Pathfinder School transferred to North Witham to train crews accurately to mark the landing points for the vanguard of specialist paratroops who would set up 'Eureka' beacons to guide the aircraft carrying the main paratroop force to the drop zones. On the evening of 5 June 1944 the first Americans destined to land on French soil duly took off from here.

Postwar, the airfield reverted to the RAF's No.40 Group, housing various Maintenance Units (MU) and being used for bomb storage. In December 1948 it was placed on care and maintenance following the departure of No.93 MU. Formally closed in 1956, the site was sold in 1960.

With Chris acting as Pathfinder, a longish stroll eventually brought us to the perimeter track, which nature is trying hard to reclaim. We followed this to find a number of overgrown 'spectacle' dispersals, as well as some undergrowth-covered humps. These, I took to have been air-raid shelters.

We followed the peritrack round to a locked gate, beyond which lay one of the T2 hangars, now the realm of Witham Specialist Vehicles Ltd, a vendor of ex-military vehicles. Reference to Google Earth suggested that they could easily equip a sizeable army.

*RAF North Witham: nature reclaiming the runways*

Backtracking, we reached our first runway. Originally all three runways would have been fifty yards wide, the main one (in this case 02/20) 2000 yards long, and the other two 1400 yards. Some parts of these remain full-width; others are much reduced. It was impossible to see what lay under the scrub vegetation, but many wartime runways, laid in a series of concrete sections, were subsequently broken up and removed to serve as hardcore. There is something rather moving about the threshold of a disused runway, with tufts of grass growing through the interstices and the ghosts of wartime aircrew running through pre-take-off checks never far away…

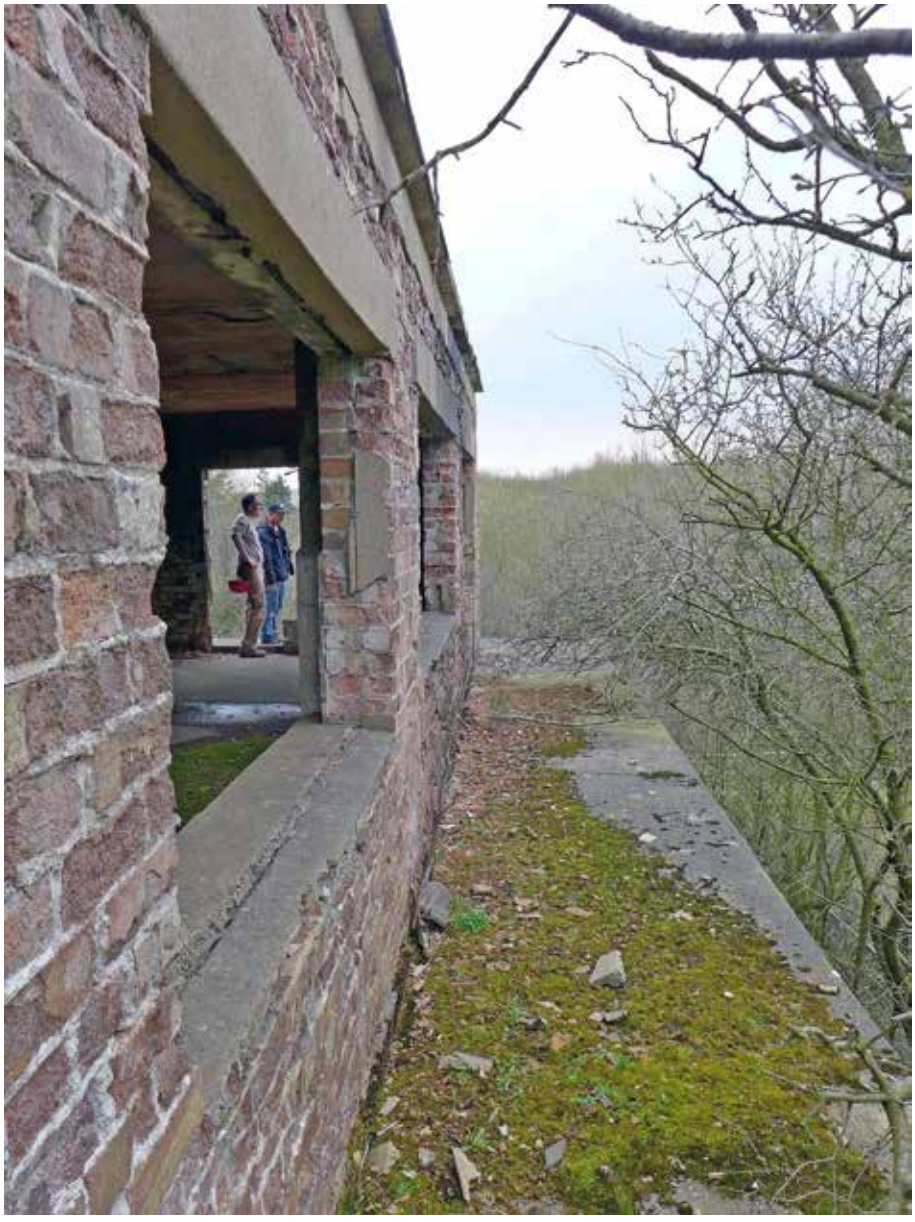
*RAF North Witham: the Type 12779/41 Watchtower*

And so to our final objective: the control tower. This was a Type 12779/41, originally designed for use on Training Airfields but, from 1943, adopted as a standard "Watch Tower for All Commands". It had two operational storeys plus a low basement: a working example can be seen at IWM Duxford.

North Witham's is now just a brick shell, having been entirely stripped out, bar a handful of window frames. Even the cement rendering has mostly peeled off. Clearly in a state of active dilapidation, it had been fenced off (although in a manner that no longer precluded access) and had a small green sign attached to one wall stating: NOT FOR PUBLIC USE. To what use the public might put a ruined Type 12779/41 eluded our understanding, but we observed the letter of the law and put it to none.

Our exploration completed and 'Cleared for Departure', we duly departed North Witham via the adjacent runway, setting headings for home. Pathfinder Gray dropped a couple of us off, on time and on target, at Grantham railway station. Here I was able to inspect the very early passenger tunnel running under the railway, concluding a most interesting day delving into different aspects of the past.

*The first floor of the Watchtower, with the internal stairs to the left*



*The Watch Tower: "Cleared for Departure"*

Our thanks are due to Chris for organising and facilitating it. I'm also grateful for his input to this article.

All photos are by the author unless shown otherwise.

# Preparing for Armageddon: the Cold War bunker at Gravesend

## Part one: Origins, description and function

**Victor Smith**

*SUMMARY: A substantial concrete bunker under Woodlands Park at Gravesend is an archaeological reminder of governmental and popular anxieties during the Cold War that Britain might come to be enveloped by a devastating nuclear conflict. It was built in 1954 and is a well-preserved example of a command post for the local coordination of civil defence, whose operations were largely reflective of the pattern of organisation across the country.*

*This case study describes and discusses the design and rationale of the bunker within a Thameside context and against the background of the political, strategic and other factors which brought about its origins, guided its development, led to its operational demise and to eventual succession by a replacement bunker not far away. This, in turn, was to be abandoned. For both the present and the future there remain questions of growing complexity about the nature of current and possible future threats to Britain and its allies and how best to provide civil and military protection against them.*


*Refurnished District Control Room, with tables arranged in one of a number of known historic layouts. Photo Victor Smith*

### Introduction

The bunker was established as one of a network of many now almost forgotten local civil defence control centres which formed the nerve-centres of a national infrastructure of preparedness. Drawing upon the experience and organisation of the Second World War, such centres were not only for directing the rescue of survivors from bomb-damaged ruins but also for coordinating a broader range of civil defence responses in the community.

By the date of its building however, the expectations for British civil defence based on a wartime frame of reference had started to be questioned by home defence planners who recognised the implications of the overwhelming and apocalyptic scale of atomic and then thermo-nuclear destruction likely to occur in the event of an attack. With this came the prospect of millions of war dead and injured and of irradiated and displaced people across a destroyed and poisoned landscape, so many indeed as to be beyond the practicability of assistance in the probably very extensive worst-hit areas.

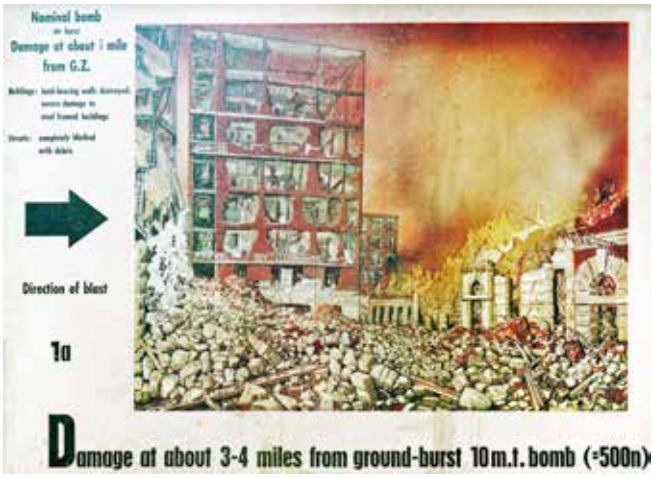
To support surviving local resources there was, for a time, national provision for the use of mobile columns of personnel drawn from the armed services, fire brigades and the police to do what they could or seemed justified in the outer areas of destruction. Painful choices about who to help would have had to be made. From the mid-1960s there was a pragmatic shift in the purpose and operation of civil defence more towards providing a communications and command focus for the survival of those in the less obliterated parts of Britain, compatible with the need to re-establish viable communities, essential services and, indeed, the country and the state from whatever remained after an attack.

*Entrance to the bunker. Photo Victor Smith*

Although planners acknowledged and addressed the brutal realities and practicalities which limited the scope of a rescue response to a nuclear attack there was, at least publicly, a governmentally expressed optimism or hope about survival. In time Gravesend's bunker became a casualty of a process of national changes to civil defence leaving it, on abandonment, as a time capsule of the early Cold War.

The archaeology of the First and Second World Wars has increasingly been the subject of study and reporting as well, progressively, of conservation and public access. In the decade following the opening of the Berlin Wall in 1989, which symbolised the end of the Cold War, academic consideration began to be given to the sites of that period, especially as many of them seemed at risk of demolition.

In the United Kingdom this soon became a particular interest and theme of Subterranea Britannica and other bodies, with continuing inclusion in the journal of




*Poster. A contemporary British vision of nuclear destruction. Courtesy Nick Catford*

the Civil Defence Association. Parallel with this, the significance of the archaeology of the Cold War as an under-studied resource became recognised by the Royal Commission on Historic Monuments for England (RCHME) and the new English Heritage into which it was merged in 1999.

This gave rise to their inception of a programme for field investigation of a wide range of military, governmental and civil defence related structures leading to the production of a flow of monographs. Derived from this, English Heritage's seminal and wide-ranging published national study of 2003 prominently mentioned the bunker at Gravesend, which had already been placed on public display through a local initiative. In 2013 the completeness and national historical value of this structure led to its designation as a Listed building.

## Historical Background and strategic context

In keeping with the intent of the United Nations, the end of the Second World War led to hopes for more peaceful and stable international relations. However, alongside the appearance of various regional, post-colonial and local conflicts, this became challenged by the rapidly re-emerging earlier mutual suspicions and ideological differences between the West and the Soviet Union, ultimately threatening insecurity and war on a world scale.

Worryingly also, whereas at the end of the conflict the forces of the wartime western allies were in the process of being dramatically reduced in size, those of Russia continued to be maintained into 1946 at a near-war level. The publicly expressed prediction of Stalin in February of that year of the inevitability of war between the East and the West, responded to by a seminal 'Iron Curtain' speech by Churchill in March, provided the mood-music for the inception of an era of global ideological and political competition, hostility and an arms race, soon to be labelled a Cold War. This was destined to become the dominant feature of international relations for 45 years.

In the West, from 1949, the framework for defence became the United States-led North Atlantic Treaty Organisation (NATO) and, in the East, by 1955 the

security relationships between the Soviet Union and the Eastern European states it dominated gestated into the Warsaw Pact.

Although the Cold War was characterised by the threat of a mutually-destructive nuclear holocaust this was far from an immediate risk. Russia did not explode her first atomic bomb until 1949, although this was several years before the predictions of the West. Even then, it took time for her to build up sufficient stocks of weapons and a strategic bomber force with which to drop them.

The development of long-range missiles was in its infancy on either side and the first generation of rockets with the potential to carry an atomic warhead had insufficient range to reach Britain from Soviet territory. It was thought that there would, in consequence, be time to prepare against a Russian air threat, perhaps until 1952– 53. 'Most immediately, however, there was a fear of the possibilities for a pre-emptive Soviet strike by the use of an atomic bomb hidden aboard a merchant ship, placing British ports, including the Thames at risk. This perceived threat led to a test of a ship-mounted atomic bomb at Britain's test range in the Pacific in order to evaluate the possible effects.

When, after several years, a Soviet strategic bombing force became a reality, it was accepted that there might be attacks with high-explosive bombs and even poison gas against specific military targets at the start of a war, which might have been initiated with a land conflict in Continental Europe. But the presumption was that in the future any Russian strategic air offensive would include the use of atomic weapons. Predictions of likely targets in Britain varied and evolved over time.

British planners thought that there would be strikes against British air, naval and military bases, as well as essential port infrastructure and some cities, especially London, in which the political and economic life of the country was centred. Just across the Thames from Gravesend, Tilbury docks was one of the ports from which allied forces, if engaged in fighting on the Continent, could be re-supplied and it was, at least, a possible candidate for an attack.

*Aerial photograph of Chatham naval base in 1972. Photo Britain from Above*

Elsewhere in the Southeast possible bombing objectives were the naval bases at Chatham and Sheerness as well as the port of Dover with, besides, a number of military airfields and other locations, including oil stores and refineries, especially along the Thames. But there were, of course, a great many targets from which an enemy might choose whether in Britain, Europe and the United States, with the result that the initially limited number of Russian air attack assets would have had to be rationed.

## The revival of Civil Defence from the late 1940s

Records for Kent and elsewhere show that even before the end of the Second World War, the infrastructure of civil defence had been largely discontinued. In Gravesend as elsewhere, premises, equipment and vehicles had been disposed of and personnel, whether full-time or voluntary, released from service. Although central government encouraged local authorities to plan against future war contingencies there was lukewarm interest among many of them in doing so.

*TU4 'Bulls' in flight, one apparently dropping conventional bombs. Photo Mike Potter*

This was soon to be changed by the Civil Defence Act of 1948, which laid a local duty on them to begin the re-establishment of civil defence, including formation of a Civil Defence Corps made up of civilian volunteers, whose predecessor organisation had been so familiar a sight in communities during the war of 1939–45. At the same time the wartime Auxiliary Fire Service was reformed, with a station locally in Brook Road, Northfleet. A risk of war arising from the Russian blockade of Berlin in 1948/9 seemed to give these measures additional meaning, even though at the date of the confrontation a weaponised atomic threat to the West was not then in being.

Despite the demolition of large numbers of wartime air-raid shelters across Britain in the years following 1945, during 1950– 51 occurred the first of a number of national surveys of what remained of them to determine their possible future utilisation for civil defence purposes. For a short time further demolition of British air-raid shelters was even discouraged. But, expressing ambivalence, there was no commitment within central or local government to spend money on their maintenance.

## Civil and military defence

In 1948 civil defence was officially defined as 'including any measure not amounting to actual combat for affording defence against any form of hostile attack by a foreign power of the whole or part of its effect, whether measures are taken before, at or after the time of the attack', and

primarily expressed in local schemes of organisation and preparedness. Yet in a wider sense as well as providing humanitarian assistance to people and communities, civil defence helped the ability of the country to continue to function and to fight. As such it sat alongside a wider suite of defensive preparation for the homeland that included active air defence by anti-aircraft guns and fighter interceptors.

Both categories of protection embraced the Thames in which Gravesend was located, supported by early-warning radars at Dunkirk near Canterbury, at Dover and south Essex. There was also a network of ground spotters from the Royal Observer Corps which had been reformed in 1947. At this period the likely Russian aircraft for bombing targets in Britain would have been the piston-engined TU4 'Bull', a derivative of the American B29.

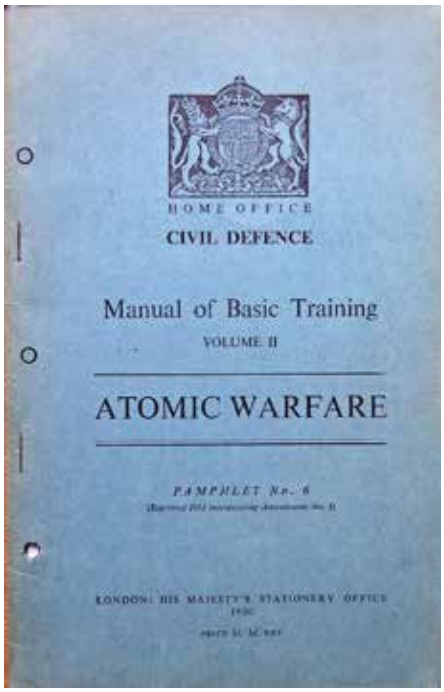
Other defences were the coastal artillery and a mine-watching and reporting service which had sites on the banks of the Thames. To replace wartime provision, a cross-river boom defence was established between Minster and Shoeburyness which, with the bomb-in-a-boat fear in mind, some have suggested was, at least in part, intended as an inspection control and an obstacle.

*The post-WWII boom defence at Shoeburyness. Photo Victor Smith*

There were also ground forces. From 1952 these were supplemented by a reformed Home Guard, of which there was a battalion in Gravesend. This defensive package had added pertinence during the Korean War (1950-53) when, especially after 1952, there seemed to be a risk of this spreading to a conflict with the Soviet Union, involving action in Europe and perhaps air and naval attacks on Britain, including against Thames and Kentish ports.

The latter came behind a protective buffer formed by NATO's naval Channel Command which, with powerful multi-national designated forces, exercised control of the waters of the English Channel and the southern North Sea, including the outer Thames Estuary. In advance of Kent-based air interceptors was a NATO air defence shield based in Continental Europe. For the Thames and Medway during this period, the scenarios for civil defence exercises sometimes included the assumed involvement of parts of these military elements in the story line.

An imperative for postwar economic recovery meant that it was not possible for Britain to invest in the formation of large and expensive military and air striking forces while, at the same time, making sufficiently comprehensive provision for the introduction of civil defence on a scale that atomic warfare demanded. In partnership with her NATO allies, Britain's defence was to be based on the collective possession of powerful retaliatory forces to deter an attack, combined with the formation of civil defence at an affordable level. Re-establishment of civil defence followed instructions set out from 1948 in a flow of prescriptive circulars and manuals from the Home Office, implemented under the watchful eye and supervision of the relevant county civil defence authority, Kent's being based in Maidstone.




*Cover of the Manual of Basic Training, Vol. II, 'Atomic Warfare'. Photo Victor Smith*

As in Britain more generally, first came the setting up in Gravesend of a local organising secretariat and the appointment of its permanent staff. Then followed the recruitment of the mainly volunteer personnel into five sections to perform the specialised services and tasks so familiar from the Second World War:

1. HQ Section: manning static and mobile controls, undertaking reconnaissance in the community after an attack, as well as providing scientific advice to controllers.
2. Warden Section: manning warden posts, providing a link with the community and rescue services, reporting on bomb damage and casualties to controls.
3. Rescue Section: helping with recovery and rescue assistance, alongside fire and other services.
4. Ambulance and First Aid Section: giving first aid to casualties and organising their evacuation to Forward Medical Aid Units and on to hospital. This was to work in liaison with the National Health Service and the NHS Hospital Reserve.

5. Welfare Section: helping with schemes of evacuation and providing shelter in rest centres and elsewhere for the bombed-out.

Courses of civil defence training started to be given. Parallel with this was the gradual designation of premises at which civil defence volunteers could be based. To direct them in the event of war, a control organisation under the HQ section was to be re-formed. Taking civil defence forward within a frame of reference and experience of the Second World War must initially have seemed workable.

Parts of the country considered vulnerable to the effects of an attack were categorised as Evacuation Areas. Given the vulnerability of London, Thameside and Gravesend among many other areas and communities were so designated. Numerous localities in Kent then perceived to be safer were earmarked for the reception of evacuees. In these early years it was thought by some planners that a war combining the use of conventional and atomic weapons might be fought and won or, at least, survived.

## The 1950s proposal for a Civil Defence Control Centre at Gravesend

For the most part, as in Gravesend, progress with creating a civil defence organisation for Britain was not rapid, recruitment of volunteers taking 18 months or more after 1948 to start to yield the prospect of worthwhile results. The securing of operational premises was also often slow.

An early success in Gravesend was the occupation of rooms at Milton Chantry at the Fort Gardens on Gravesend's riverside for use as a training centre. Consistent with general practice, the local secretariat was, from the start, accommodated at council premises, in this case at Woodville Terrace, also in Gravesend. Reflecting the position nationally, as late as July 1950 no local operational plan for civil defence had been framed. Neither had premises for control been designated. Indeed, and despite protest, for some reason the Police steadfastly refused reoccupation of the specially designed existing wartime control centre in the basement of the Police Station in Windmill Street.

*Milton Chantry, initially used for civil defence training, viewed in the later 1950s.*
*Photo Gravesend Historical Society*

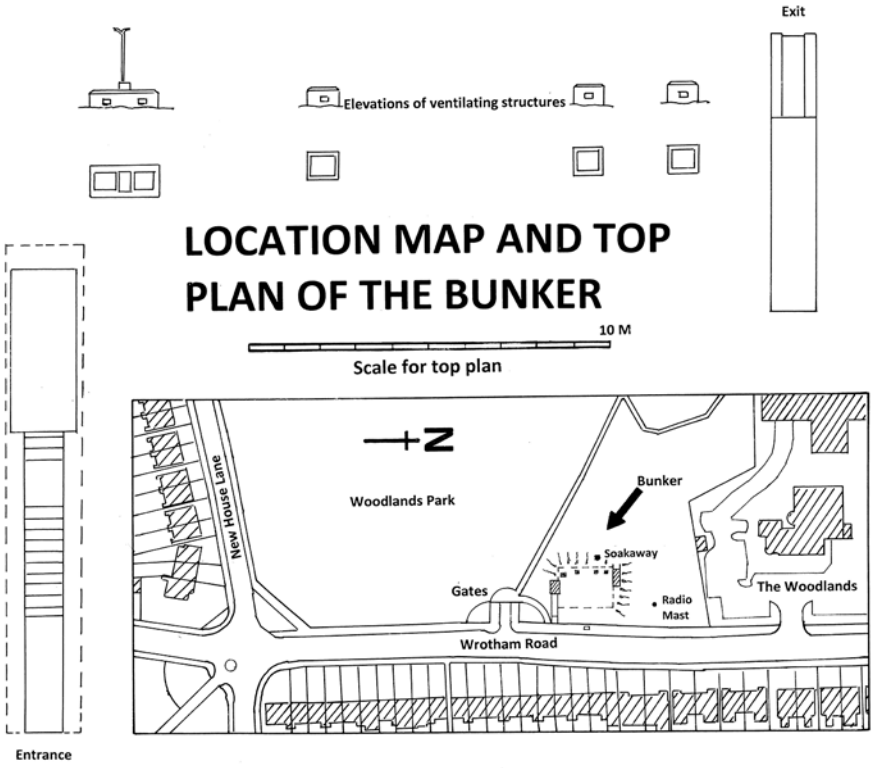
The Second World War air-raid shelter tunnels in cliffs behind the Henley factory at Northfleet were briefly considered but this idea was not pursued. In desperation, by October 1951 unspecified premises at the riverside Fort Gardens were earmarked for temporary use, perhaps either utilising the magazines of the fort or the ground floor of Milton Chantry, a building already in use for training purposes.

In the same year central government issued guidelines for the design and working of control centres, their components being reflective of Second World War practice. But for Gravesend it was not until April 1952 that a permanent location for a control centre was agreed. This was away from the town centre, partly on the site of an underground Second World War public air-raid shelter behind some 1935 ornamental gates near the northeast corner of Woodlands Park south of Gravesend. Even then there were difficulties over an apparent insistence by the Home Office on the ability of control centres to be resistant to a direct hit by a conventional high explosive bomb.

This began to require a change to design that in some elements was, for practicalities, set aside. A council briefing note of June 1954 stated that siting at Woodlands Park 'was very carefully considered and, being in an open space, access could be obtained under all conditions; the maximum possible safety from fire and debris hazards also being obtained.' Government advice was that control centres should, wherever possible, not be near possible targets.

However, and without reference to location vulnerability, the same government advice acknowledged that if protected accommodation could be provided in or near the offices of the authority concerned, with direct availability of council staff, then that course would be acceptable. Indeed, at this period many control centres were re-activated Second World War control accommodation beneath or next to council offices, as its enhanced existing or new contemporaries were at Northfleet and at Gillingham.

*Portrait of the builder, the late George Rattray, at about the date of construction of the bunker.*
*Photo late George Rattray Collection*




*Location map for the bunker. Drawing Victor Smith*

Gravesend's bunker was a dual-purpose control, its functions being both to direct operations in the Borough of Gravesend itself (designated a Civil Defence District) and, at a higher level, to coordinate across the three Districts of Gravesend, Northfleet and Swanscombe (called a Sub-Division). This was the same approach as adopted at another control centre which covered both Gillingham itself and the whole of the Medway Towns. In keeping with other parts of the country, peacetime planning for operations in the Sub-Division was guided by a standing joint advisory committee, functioning within parameters set by central government.

*The bunker under construction in 1953.*
*Photo late George Rattray Collection.*

Gravesend's control centre was assigned priority for building and construction began in April 1953, contracts having been let to George Rattray for building and to J Jefferys for the installation of emergency power supply and ventilation plant. The final overall cost was £11,000. The work involved a deep cut-and-cover excavation, which might have destroyed part of the pre-existing Second World War air-raid shelter on the site. There were no piles, the structure being built directly on to what the contractor described as 'Windmill Hill Sand'. A metal reinforcement structure was first inserted, into and over which was poured the concrete. No waterproofing was applied to the bunker.

As construction progressed, the strength of civil defence volunteers for Gravesend for the Sub-Division rose to over 200 and appointments were made to a small number of paid positions. The Town Clerk, F W Harrison, was made controller of the Sub-Division. Reflecting national objectives, an industrial civil defence corps had begun to be formed at some larger nearby industrial and commercial premises, such as at the paper-making conglomerate Bowater at Northfleet.

A training headquarters in Woodville Terrace, Gravesend was, under standard practice, provided with a safe for the holding of radioactive materials to demonstrate the use of radiation detection equipment for training purposes. Finding places in which to practise rescue and other field craft was a continuing challenge for civil defence units up and down the country, the use of derelict or partially demolished buildings often being secured, as in the case of Gravesend, next to Woodville Terrace. Despite a scramble for buildings to use for civil defence, Gravesend's council continued to release a number of wartime warden posts for use by the Scouts and other youth organisations.

Elsewhere in the new Sub-Division financial approval had been given by the Home Office for the construction of a District Control in a buried situation at the rear of Northfleet Town Hall, next to its wartime predecessor in the basement of the latter. This, as explained earlier, was to report to the bunker at Gravesend.

Money was also found for modest adaptations to a pre-existing control centre at Knockhall Lodge, Greenhithe, providing the third District Control, in this case for Swanscombe, and also reporting to Gravesend, so completing the control chain across the Sub-Division. Progress with the provision of air-raid sirens was also made, 15 being designated across the Sub-Division for remote activation. So too, and again forming part of national trends, there was contingency planning for the earmarking of schools and community halls as rest and emergency feeding centres for those made homeless after being bombed out, just as they had been during the Second World War.

At the same time, and following the earlier designation of the Sub-Division as an Evacuation Area, contingency planning began on a scheme for the removal of defined groups of the population considered to be at risk. By the summer of 1954, the actual number of civil defence volunteers serving across the Sub-Division against the required establishment (in brackets) was:

**Gravesend**

HQ 23 (65)
Wardens 51 (171)
Rescue 18 (176)
Ambulance and First Aid 27 (52)
Welfare 34 (195)

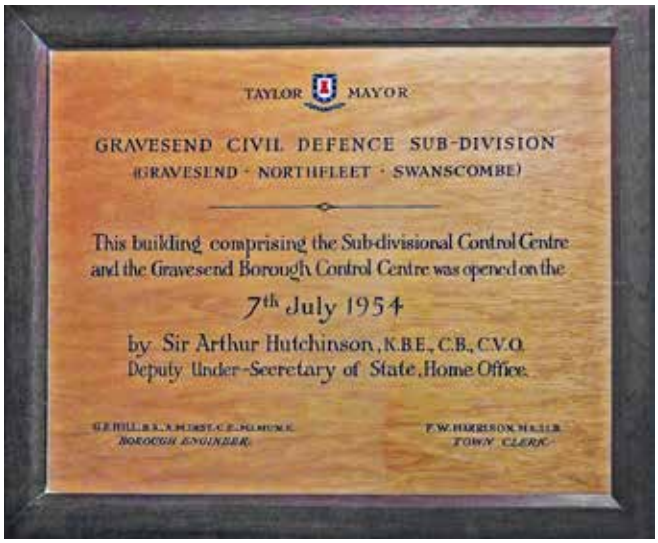
**Northfleet**

HQ 10 (28)
Wardens 16 (110)
Rescue 7 (80)
Ambulance and First Aid 13 (20)
Welfare 19 (82)

**Swanscombe**

HQ 3 (12)
Wardens 20 (30)
Rescue 4 (36)
Ambulance and First Aid 8 (17)
Welfare 24 (34)

HQ sections comprised sub-sections of intelligence and control operations, signals and later Scientific Officers. Overall strength against establishment was very inadequate but this was not an untypical situation across the country.




*Commemorative plaque on the wall of the spine corridor. Photo Victor Smith*

With a drying-out period for Gravesend's new bunker and its fitting out, it took time for it to be completed and opened, as it ceremonially was on 7 July 1954, by Sir Arthur Hutchinson, Deputy Under-Secretary of State at the Home Office. In the presence of other dignitaries, he inspected uniformed civil defence staff and their vehicles, after which the bunker was opened to viewing by members of the public. The occasion was marked by the unveiling of a wooden plaque which remains on the wall of the bunker's spine corridor.


NORTHFLEET REPORTER,
KENT & SOUTH ESSEX ADV

SATURDAY, JULY 3, 1954.

*Mr. A. P. Birch, Civil Defence Officer, inspects the mechanism which, in the event of an emergency, would put into operation all sirens in the district.*

*Newspaper publicity for the bunker in July 1954, showing activity in the Message Room. Photo Gravesend Reporter*

This dual-purpose control was the first of an intended pattern for a network of others across Kent, slow to be provided. All were to report to a county control at Maidstone. This, in turn, came within the embrace of a Regional War Room at Tunbridge Wells (in operation from 1953–58). Under the charge of a Regional Commissioner, this was responsible for the strategic coordination of civil defence, police, fire and medical services, and distribution of utilities across the region. It has been suggested elsewhere that in extremis it could also be used, in however limited a way, for the continuation of the government in its area should central government be unable to act.

## Functional layout of the control centre during its operational existence 1954-1974

Next to Wrotham Road and under the sloping eastern edge of Woodlands Park, the north-south oriented bunker is, in effect, a buried and compartmentalised 65ft (20m) x 45ft (14m) reinforced concrete box. It was built to the then full Grade 'A' standard of structural resilience, with the main concrete walls and roof 18in (45cm) thick, the sides being considered to have substantial lateral protection.

Confirmed by the writer's limited excavation in 2001, the roof is covered by 15in (38cm) of earth. At 4 1/2in (11.5cm), the sub-dividing internal walls are thinner,

being constructed of brick. The walls inside the bunker were first painted in a pink distemper or emulsion, later over-painted in a yellowish cream. The doors were painted grey in a semi-gloss. From the outside the bunker presents as a modest grassy mound, with several protruding low concrete ventilation structures and, at either end, a concrete entrance and exit, the former being metal-fenced.

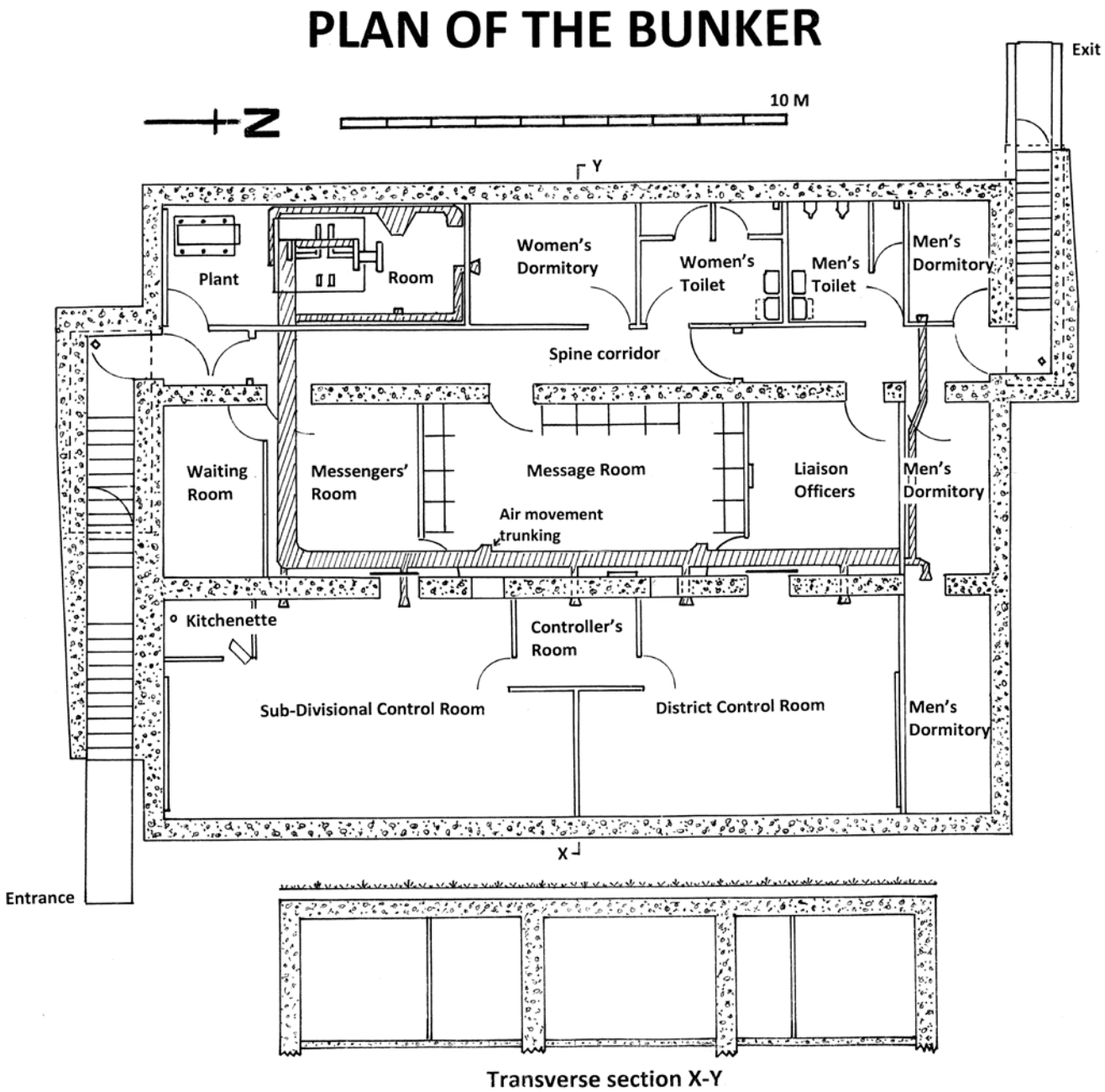
The current railings replaced the damaged original ones. Within the building are thirteen 9ft (2.7m) high rooms reached down the blast-baffled entrance staircase from the adjacent Wrotham Road. At the opposite end of a spine or axial corridor is an emergency exit with egress up a second flight of steps into the park.

The interior of the bunker is divided into four functional elements: (1) emergency power plant for lighting and ventilation; (2) dormitories for male and female staff; (3) communications and (4) control rooms for receiving information about the extent of damage and casualties in the locality and for decision-making by the command staff about how to deploy the resources they controlled.

## Description of individual rooms and features

### The entrance and exit

The entrance and the exit consist, respectively, of descending and ascending concrete steps roofed by a flat canopy, partially in the first case and entirely in the second. The entrance canopy is formed of precast panels of a type that might have been recycled air-raid shelter sections from WWII. A right-angle turn at the bottom of the entrance steps gives access to the bunker through two wooden doors. These are pierced by flapped letter-box-like openings. Because of repeated attempts by vandals and others to break in to the bunker during subsequent years, a further door was mounted halfway up the entrance steps.




*Plan of the bunker. Drawing by Victor Smith*

*The outside of the bunker viewed from within Woodlands Park. Photo Victor Smith*

For the same purpose another was fixed at the top of the exit steps.

There are small drainage sumps at the foot of the entrance and exit staircases to receive any rainwater from outside, a potential source of contamination after an atomic attack. A shortage of funds led to another vulnerability: the absence of airlocks which were to be ordered for supply and fitting only in a period of emergency.

**The spine corridor**

The 4ft (1.2m)-wide spine corridor between the entrance and the exit provides access to all rooms of the bunker. The names of the rooms are given on original signs either fixed to the walls of the corridor or suspended on chains from the ceiling. Fastened to the wall, close to the entrance end of the corridor, is the earlier-mentioned wooden plaque unveiled during the ceremonial opening of the bunker on 7 July 1954.

**The plant room**

Labelled 'Ventilation Plant' on the original plan, this 22ft 3in (6.8m) x 9ft (2.7m) room has a pair of electric fan motors (one held in reserve) mounted on a concrete base to draw in air from the outside, passing it through carbon filters for cleaning and then circulating a flow through the building via metal ducting which runs round at the junction of the walls and the ceiling. This system, described in official documents as an anti-gas fan, would also have been able to filter out radioactive particles entering from outside, although this second function is never mentioned in documents.

There was also a heating element which could, if necessary, be switched on to warm the circulating air passing through the ducting. A former civil defence commander for Kent has commented to the writer that, however coincidentally, activation of the ventilation system applied a degree of positive pressure to the inside of the bunker, providing some resistance to the entry of any contaminated air outside the bunker through the entrance and exit doors. The ventilation plant was electrically connected to the national grid but in the event of the failure of the latter, an emergency Petter 6 KVA diesel generator was fixed onto another concrete base. Its doubled-headed


*Spine corridor looking back towards the entrance doors, with their flapped apertures. Photo Victor Smith*

exhaust pipe projects above the bunker outside.

The generator was also intended to provide power for lighting and the power sockets throughout the bunker. Although regarded as sufficient to cope with all needs, its maintenance electrician asserted to the writer that the generator was not powerful enough. Some demands would have had to be reduced. There could be no compromise in the case of the need to run the ventilator plant when its operation was needed.

Fuel was stored in jerrycans inside the plant room (diesel being a lesser fire hazard than petrol) but it is uncertain how long supplies would have lasted. The walls of the room are mounted with a variety of electrical and fuse boxes forming the original switchgear. Wall boards were provided for the display of operating guidance and instructions. A free-standing wooden cupboard contained tools needed for maintenance.

**Dormitories and toilets**

The dormitories have no integral fittings other than wall-hangers for clothing. Two-tier bunk beds were to be placed against their walls, together with free-standing cupboards for clothing and personal effects, as well as chairs, producing a rather cramped situation. There were three rooms for men and one for women. In accordance with government guidance, these provided bed space for eight men and six women. Some personnel might also have been constrained to sleep on mattresses placed on the floor but as has been suggested for bunkers elsewhere, a 'hot bed' system might have operated, with staff going off duty getting into the bed just vacated by someone going on duty.

*Interior of the plant room. Photo Victor Smith*

There were separate toilets for men and women. The features common to both male and female toilets were cubicles for Elsan chemical buckets, ceramic sinks and 'Sadia' electric water heaters. The water supply comes from a wall-mounted tank fed from the mains and, should the latter be isolated for fear of contamination following an attack, or suffer damage, there appears to have been a reservoir in a buried tank outside found by the writer during keyhole excavation. The men's toilet had a pair of ceramic urinals flushed from overhead cisterns.

Waste water from all of the sinks passed into a drain, then vented into a soakaway in the park outside. The contents of the Elsans would have had to be emptied onto the ground outside, risking contamination from radiation of those carrying out this task.

The capacity of the presumed reservoir water tank is unknown but in operational conditions, it would have been prudent to carefully ration supplies, perhaps significantly compromising hygiene. Timely resupply of water might have been uncertain.

*Refurnished Women's Dormitory. Photo Victor Smith*

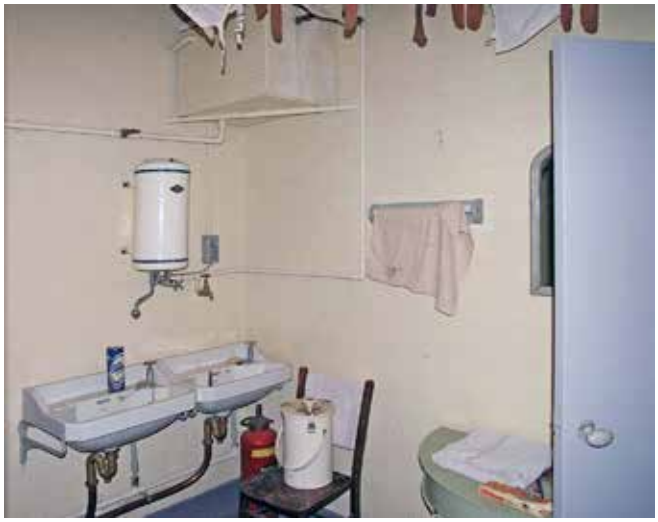
**Communications**

These were the means of receiving and sending messages from and to, the outside world, whether by telephone, teleprinter, wireless or by messenger.


*Refurnished Men's Dormitory. Photo Victor Smith*

Knowing what was going on outside and being able to influence a local civil defence response through the issue of orders was the essence of the function of the bunker. Communications were performed within the four rooms along its centre. Based in the bunker there was also a field telephone cable unit.

The private manual branch exchange (PMBX), which included direct lines was positioned in the corner of the 12ft 6in (3.8m) x 11ft 6in (3.5m) **Liaison Officers' Room** and, on the wall next to it, was a cabinet containing the marked telephonic connections, including one for the WB400 attack warning system. The latter would have been introduced in the early 1960s. It would normally emit a steady ticking sound but when the national attack warning system was triggered it sounded a chilling wailing note. There is



*Refurnished Women's Toilet. Photo Victor Smith*

a telephone junction box under the path of Wrotham Road nearby, from which cable spurs enter the bunker. This room was furnished with desks, chairs and filing cabinets, as well as wall-boards. The liaison function was to provide space for a small number of staff who would act as intermediaries with the public services outside, such as fire, police and the military, possibly through the agency of the Territorial Army.

The telephonic nerve centre was the larger 23ft 3in (7.1m) x 12ft 6in (3.8m) **Message Room** on the south side of the party wall from the liaison officers' room. Its distinguishing features are the twelve timber telephonists' cubicles, known as phonogram booths, fixed to three of the walls. Half of these were for receiving incoming calls and half for making outgoing

*Manual exchange in refurnished Liaison Officers' Room. Photo Victor Smith*

ones. Old-pattern candlestick telephones were used. A supervisor sat behind a central table and a messenger took message forms completed by the telephonists and passed them through hatchways in the partition walls with the two control rooms and, reciprocally, received messages back to be given to the telephonists for sending out. During training exercises most telephone contacts were with the control centres at Gillingham and Maidstone.

*Refurnished Message Room. Photo Victor Smith*

A pair of teleprinters (one for incoming and the other for outgoing messages) were on tables against the other long wall, on which was mounted a cabinet containing the equipment to operate the air-raid sirens in the district. Somewhere in this room there was also a wireless transceiver and a store of six walkie-talkies which could be used outside in connection with a radio communications vehicle.

The 12ft 6in (3.8m) x 11ft (3.4m) **Messengers' Room** on the south side of the party wall was for the debriefing of foot, cycle, motorbike and car messengers bringing information from the outside and for giving them messages or orders to take out. The room was provided with tables, chairs and filing cabinets and a wall information and map board. There is also a wall-mounted electric bell, perhaps sounded from a bell-push once outside.

Next to this is a small 12ft 6in x 7ft 6in (3.8m x 2.3m) **Waiting Room**, for those coming from outside to be called in to the Messengers Room or to receive messages to take out. This was also provided with chairs and a table.

**Command and Control**

The two control rooms are entered via sliding doors, one from the Messengers' Room and the other from the Liaison Officers' Room. Information received was to be analysed and orders issued from within them and, passed through the hatches, into the message room for onward transmission. The two control rooms are separated from each other by a thin partition wall and by a timber-framed Controller's Room.

The northern of the control rooms is the 24ft (7.4m) x 16ft (5m) **District Control Room** for Gravesend with wall boards at its ends and side. These were variously (a) tally boards to record the available civil defence resources outside which could be deployed as well as information about casualties among the population and (b) maps on which pins were inserted to mark civil defence rendezvous points, refugee collecting centres, warden posts, emergency feeding centres and other

*Hatchway from Message Room. Photo Victor Smith*

assets as well as to show the evolving situation outside. Alongside an Operations Officer, tables were provided in a line for the five heads of civil defence sections.

Other tables were later provided for the scientific staff who plotted information about fallout notified by the Royal Observer Corps (and about chemical and biological agents, if encountered), advised the Operations Officer and recommended the sending out of reconnaissance parties where this seemed necessary. There were also places for plotting staff and a movements officer. Elsewhere against the walls of the room were a plan chest and filing cabinets.

The longer, 30ft (9.2m) x 16ft (5m) southern **Sub-Divisional Control Room** for Gravesend, Northfleet and Swanscombe was arranged in a similar way, having the same types of staff but its southwestern corner was divided into a 6ft (1.8 m) x 4ft (1.2 m) space by a wood panel wall. This is not explained in plans or documents but is remembered by an eyewitness to have been a small kitchen and retains a low servery door, its internal space being within government guidelines for a food preparation area. This had no fixed fittings or furniture although there was a power point. The latter was sufficient for a Baby Belling cooker or similar. A fume pipe rises from this space to an outside vent. There was no water supply in the kitchen itself, this having to be taken in containers from taps in the toilets. Emergency food rations were held in boxes. At some point the women's dormitory became used as a kitchen.

The timber panelled and upper glazed 8ft (2.5m) x 6ft 6in (2 m) **Controllers' Room** provided a place from which operations in either control room could be overseen, being provided with doors into them. It has a power point but no fixed furniture, just a desk and a hat stand.

**The radio mast**

Positioned 40ft (12.3 m) northeast of the bunker, this is a galvanised 30ft (9.2m) high octagonal roadside-type lamp standard. Although it has an improvised look about it, a removable cover at the base of the mast is marked with a microphone symbol but an antenna is missing from the top. Cables run under the grass from the mast to the exit of the bunker and then as a co-axial run at the top of the inside walls into the Message Room. This mast may not have been part of the original construction, perhaps coming later.

There would, at the outset, have been some type of aerial and an eyewitness remembered an antenna being tied to a nearby tree. The originally intended location of a permanent mast was to have been a little further away to the northwest and, for environmental reasons, it was to have been painted green in an attempt to blend in with the surrounding park.

**The soakaway**

This circular 9ft (2.7m) deep and 8ft (2.5m) diameter concrete- lined shaft, which was dug to receive liquid waste entering by a pipe from the toilets, is at the foot of the bank on the west side of the bunker. It is closed at the top by a metal inspection cover.

The functional elements of bunkers and their contents followed mandatory Home Office instructions which were to provide for 'control, liaison, receipt and despatch of telephone messages and despatch carrying'. As long as these key elements were provided, the exact layout might, in some degree, be varied according to local circumstances, but subject to Home Office approval via the county civil defence authority.

No establishment figure for Gravesend's bunker has yet been found but it would have required around 35 people to fully function, to which would need to be added reliefs, if available. The bunker team would have been made up of local civil defence volunteers, liaison officers and some council staff, all under the authority and direction of the Controller, Gravesend's Town Clerk. Below him were the District and Sub-Divisional Operations Officers.

## How the Control Centre would have functioned

This section outlines how the control centre would have worked. It does this by combining government guidelines with the layout of the building.

Government guidelines set out the two main processes for the control of civil defence operations as:

'(i) The collection and collation of reports of damage, including any which may arrive from higher authority or other services in advance of information from within the area

(ii) The issue of orders for the deployment of civil defence resources', adding that 'Persons responsible for arranging such deployment need ready access to collated information of damage, and it is strongly recommended that the two processes above be carried out in the same centre…'

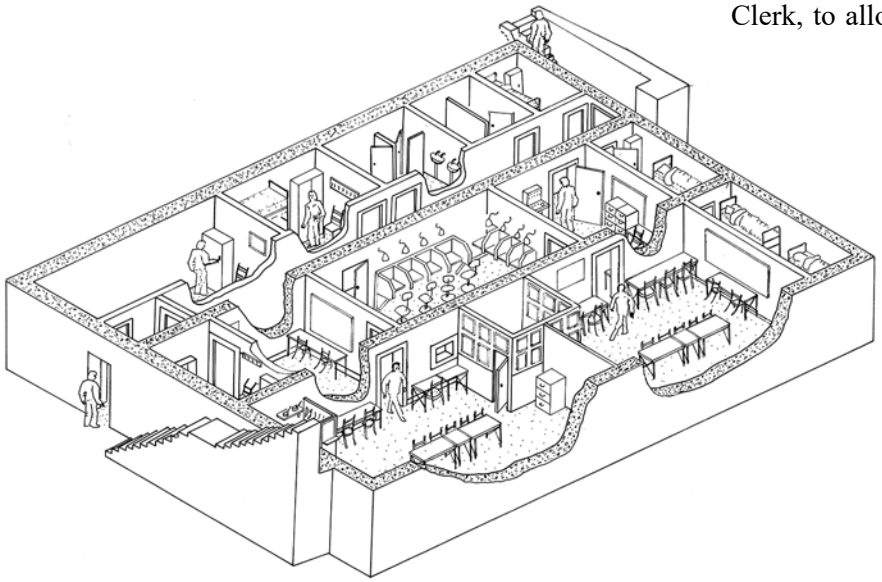
(The presence of Scientific Officers to receive and evaluate fallout information seems not to have been an original feature but was to be so later.)

As well as this, such centres were:

'(a) to provide from time to time situation reports on damage and operations for the next higher authority

(b) to call for reinforcements from outside the area, and to inform the reinforcing authority about rendezvous points and routes

(c) to give services other than the Civil Defence Corps access to information available in the centre.'



*Isometric cut-away view of the bunker. Drawing by Victor Smith adapted from an earlier drawing by English Heritage*

## The sequence of message handling

From these stated imperatives, the bunker was intended as the prepared local hub within which information about the post-attack situation outside (whether taking the form of a conventional or atomic bombardment) would be received and evaluated so that in a cycle of decision, advice and instruction, the various actions of rescue and recovery services could be directed.

At a strategic level, and alongside other district and sub-divisional controls across Kent, the bunker was expected to provide information to the county control at Maidstone, allowing the staff there to gain an overview with which to liaise, as necessary, with the Regional War Room at Tunbridge Wells. Means of communication at this level could be anything still working, including teleprinters. Local tactical information might, variously, reach the bunker by telephone from air-raid wardens' posts, brought by messengers or radioed from reconnaissance vehicles. Once received, there was an established flow-line for this to be handled:

- By telephone, teleprinter or wireless. The person in the Message Room receiving the message would write it down and an indoor messenger would give it a serial number, after which he/she would pass it through a hatch into one of the two control rooms within which were wall maps and tally boards on which to plot information.
- If brought in by a despatch carrier (on a motorbike or bicycle or on foot) the individual would enter the waiting room and the message would be taken via the Messengers Room into the Message Room in which it would be copied by a clerk or telephonist, given a serial number and passed through one of the hatches as in the case of a telephone message.
- In the Control Room concerned, another messenger would hand all copies of a message to a Plotting Clerk, to allot to each occurrence a number, and to mark that number on each message so that all subsequent reports and messages concerning that incident could be keyed to it. The original message was then to be passed to the Operations Officer, with copies to the Controller, Fire and Police officers and to the heads of civil defence services, as required and as quickly as possible.
- The Operations Officer's responsibility was: to respond to the message received, to frame, with guidance from heads of civil defence services, the instructions to be given to the places and depots at which waited the relevant reaction services. Meanwhile, the Plotting Clerk and/or assistant marked on a wall map any damage reported in the message, but not already plotted. The assistant was to maintain a running record of occurrences as they were plotted and of the numbers of the messages relating to each occurrence, also maintaining a record on the tally board of the services ordered out of depots by the Operations Officer.
- Heavy saturation bombing or an atomic attack would, from the extent and scale of destruction, have to be plotted as an area on a map rather than as an individual localised occurrence
- Messages out from the Operations Officer were to be passed through the outgoing hatch from either Control Room into the Message Room, then to be sent by telephone or passed into the Messengers Room for handling by a despatch carrier under the supervision of the Message Supervisor. (The original 'in'-

*Enactment of a bicycle dispatch carrier entering the bunker. Photo Victor Smith*

*Enactment of the dispatch carrier being interviewed by a civil defence officer. Photo Victor Smith*

message and carbons of 'out'-messages were to go to a records clerk for keeping the messages relating to each occurrence in a separate folder or clip). The clerk checked that 'out'-messages had been acted upon.

These were the intended procedures for simple 'in' and 'out' messages, perhaps based on wartime experience, but it was recognised that there would be complications arising from messages of interest to a service other than the Civil Defence Corps (eg about damage to public utilities, communications and the blocking of roads), for which suitable adjustments were to be made.

The operation of the arrangements would have depended upon control centre personnel keeping their nerve while the world outside appeared to be going mad. Anecdotally, some volunteers felt uncertain as to whether they or their colleagues would have been willing to abandon their families if called to do so on the outbreak of war or of the emergence of its perceived imminence.

## Civil Defence assets outside

If still functional, civil defence services at pre-positioned places or depots outside were to be formed of the warden service, search and rescue teams, first-aid parties and ambulances, assisted by other services such as the fire brigade, council works staff, members of the hospital reserve, the Women's Voluntary Service, the Red Cross and the St John Ambulance Brigade as well as the police and others. This reserve was publicly announced to require 3,500 people for the Gravesend civil defence district.

*Enactment of a civil defence volunteer outside the bunker taking radiation readings after an attack. Photo Victor Smith*

Many of these were to be activated at the last moment, where necessary by telephone or by the police calling at doors. For a proportion of them, including volunteers from the public, who were without prior training in civil defence, there would have to be rapid instruction sufficient for them to perform basic duties with on-the-job training along the way. How well this could or would have worked is unclear. Local units of the Territorial Army would also have been available to help.

The earlier-mentioned rest and feeding centres in schools and community halls, for the displaced and bombed-out, were to be run by the civil defence welfare services and other bodies, with overall coordination from the control centre. Some appear to have been provided with emergency rations to be stored in peacetime. There were also agencies responsible for temporary rehousing. There were, besides, special groups assigned to bury or burn corpses of local war dead.

Timely civil defence preparedness assumed the availability of an adequate warning time (called the Transition to War Period). This was to be judged from an informed governmental interpretation of a worsening international situation and depended upon the political will and judgement to set precautionary civil defence measures in train.

Civil defence would have been less able to react to a suddenly-occurring crisis. Either way, in the event of an attack, rescue services as well as the population in general would, of course, have been subject to the spread of radioactive fallout and it was understood that deployment of civil defence forces might have to be delayed because of that. Based on scientific advice, the necessary instructions for deployment locally would have been given from the bunker. With the limited personnel resources actually available it is possible that many of them would have exceeded their designated war emergency radiation dose.

At this period - and indeed to a degree later - the disabling or interfering effect on electrical communications and electrical equipment from the electro-magnetic pulse (EMP) produced from an atomic or nuclear explosion appears not to have been fully understood, giving rise to the subsequent need for the Home Office to issue guidance, however tentative, to civil defence authorities. Manual telephone exchanges and valve wireless sets were less susceptible. EMP was likely to have a devastating effect on power stations and the national grid.

To be continued….

(Part 2 will include a list of sources)

# WWII air-raid shelter at Moritzplatz U-Bahn station, Berlin

**Katie Rix**

*Inside the shelter with its blackened walls. Photo Jonny B Kirchhain*

## October 2018

On a pleasantly warm evening, a group of shifty looking people with utility belts and cameras gathered in an underground station in Kreuzberg. The district being what it is, this is nothing out of the ordinary: Berlin's hipster, alternative and antifa subcultures are all at home in Kreuzberg. But such denizens don't usually carry torches or wear less-than-fashionable reflective vests. This time it was the intrepid members of Berlin's association for the exploration, research and documentation of its historical underground sites: *Berliner Unterwelten* (Berlin Underworlds).

It was a special, members-only visit to a former air-raid shelter in the Moritzplatz U-Bahn station; one of six such stations on the U8 line which runs from Gesundbrunnen in the north to Hermannstraße in the south. Formerly known as the GN Bahn (Gesundbrunnen to Neukölln), it was also disparagingly referred to as the *Ghettobahn* because it connected two very poor, working-class districts of the city.

## Going underground

Anyone interested in Berlin's underground history could do a lot worse than to start with this subway line. The first plans for the line were made in 1907 and it was officially commissioned by the city in 1912 - as an elevated streetcar line! However it proved massively unpopular with residents of the well-to-do Mitte district who didn't appreciate having carfuls of working-class types peering through their windows as they were breakfasting.

It was reimagined as an underground line and the contract was awarded to a subsidiary of AEG. Unfortunately, manpower shortages as a result of World War I and serious financial problems meant that construction only began in 1926, this time undertaken by the City of Berlin. The GN line finally opened in 1930. The line runs comparatively deeply through Berlin and since it was constructed using the cut-and-cover method, referred to in German as the *Berliner Bauweise* (Berlin building style), there was a lot of space to fill between the tracks and the street. This led to the creation of intermediate

levels with rooms that the transport company intended for a variety of possible purposes. Unfortunately, this being only a year after the global financial crash wreaked its havoc, there ended up being no money to do anything special with those incidental spaces. They mostly stood empty; although sometimes they were used as box rooms.

## War brings need for shelters

When in August 1940 (to Hitler's immense shock and displeasure) the first British bombers managed the long flight to Berlin and began to drop their loads on her citizens, it became painfully obvious that more shelters for civilians were needed and fast. Hitler had not planned for this eventuality, believing the fuel tanks of British planes to be too small for them to make the journey. He therefore issued an order called the *Führersofortprogramm* - the immediate program of the Führer.

Bunkers were to be constructed and existing spaces were to be converted into shelters - immediately! (*sofort*). These box rooms were suddenly seen in a very different light - now as a possible refuge for unlucky U-Bahn passengers caught in an air raid during their journey.

## Dark worlds

Luckily for us historians and underground enthusiasts, many such air-raid shelters in stations' spare rooms escaped destruction during the demilitarisation of Germany by the victorious Allies after the war. To blow them all up as the hulking flak towers in Berlin had been blown up would have meant taking a lot of valuable infrastructure with them. One such surviving shelter at Gesundbrunnen is in wonderful condition with all the original paintwork and is the setting for Berliner Unterwelten's immensely popular tour

## Long division

When the city was divided into East and West Berlin, the U8 was one of the lines that started in the West and passed under East Berlin before finishing again in the West. This resulted in six stations being completely closed off to the general public and becoming *Geisterbahnhöfe* – ghost stations. Trains were not permitted to stop at these stations: they had to travel straight through at a constant speed and their progress was monitored by armed East German guards in pillboxes on the deserted platforms.

Following the fall of the Berlin Wall in 1989, the reopening of these stations became a beautiful symbol of German reunification for the locals who had been cut off from their family and friends since 1961. No more announcements at Moritzplatz in former West Berlin that U-Bahn passengers were about to pass through an entirely different country on their journey north.

Moritzplatz is in Kreuzberg and those who know their WWII history may remember that on 3 February 1945 Kreuzberg took the brunt of one of the worst air raids over Berlin. Certainly people would have been cowering in this shelter and the many others like it, wondering if their house, their district, would still be there when it was safe to come out again.

The bad news for Berliners who sought refuge in subway stations during air raids is that Berlin's sandy, wet ground makes it impossible to dig very deep. Many subway stations are accessible by just a single flight of stairs, the platforms visible from the surface. These shelters were not bomb-proof: the best they could offer was protection from shrapnel, fire, smoke and chunks of flying rubble from exploded buildings.


*Tour 1 - Dark Worlds. Photo © Frieder Salm www.berliner-unterwelten.de*

A part of that structure was also renovated in 1981 as an ABC (Atomic, Biological, Chemical) shelter. And when plans were made in 1967 to extend the U8 line north, the neighbouring station of Pankstrasse was chosen to be constructed from the ground up as a multi-purpose facility capable of sheltering 3,339 lucky Berliners for fourteen days in the event of a nuclear strike on a nearby city.

Completed in 1977 and now preserved as a historical monument thanks to the efforts of the *Berliner Unterwelten* association, these shelters feature on regular tours of the site in many different languages (Tour #3: *Cold War Nuclear Bunkers*).

## Board members

Sure enough: at Moritzplatz descending only one flight of stairs from street level brings you to the unmarked door that leads into this shelter. On that fateful night in February 1945, the station was badly damaged and 36 people were killed.

We hoped for better luck. We certainly couldn't have been in better hands: two of the leading members of the association were there to show us the shelter and point out all the fascinating details that those without their intimate knowledge could easily miss.

Sascha Keil is a gentleman that some SB members may already know if you've been to Berlin with Subbrit before

(and who you'll certainly meet if you join the Subbrit visit to Berlin in May 2019 with Tony Radstone and crew). Jürgen Wedermeyer is on the Board of the association and his knowledge of underground Berlin is right up there with that of the association's founders. Sascha had the key; in great excitement, we followed him inside.

He led us first down some narrow steps and into a low, dingy room with blackened walls. Turning to look behind us, we could see a brick wall with a space where an airtight steel blast-door used to be. Jürgen told us that the BVG had allowed *Berliner Unterwelten* to take the door away to be exhibited at Gesundbrunnen and that they had simply done so by carrying it out of the shelter, down onto the platform and taking it north on the train. Such an undertaking certainly wouldn't raise so much as an eyebrow in Kreuzberg.

The blackened walls were a surprise too since this space hadn't been blown up after the war. Jürgen informed us that during the American occupation these rooms had been used by the Americans' *Freiwillige Polizei Reserven* - volunteer police reserves - for their exercises. There had been several explosions down here during their war games that had scorched the walls. We had been warned beforehand not to wear our best clothes for the visit.

*This room formerly divided into two floors, the ceiilng level of the lower level is clearly seen as a line running roud the wall. Note the ventilation equipment high on the far wall. Photo Logan Hicks*

We learned a little about the history of the station itself – one of the relatively few in Berlin not to have been designed by the Swedish architect and engineer, Alfred Grenander. This was the work of P Behrens, a man of many talents who designed not only buildings but also typefaces and graphic art.

The station was built here because of the crammed and chaotic Moritzplatz crossroads above – its construction was not only intended to alleviate the traffic but also to provide a way for pedestrians to get across the streets without taking their lives in their hands.

Jürgen told us that there used to be a large 3-D map down here so people could quickly and easily find the exit they needed for where they wanted to go (women often heading to *Wertheim*, the large department store nearby; men usually to the local brewery!). Since this district was so terribly battered during the air raids, this 3-D map was probably removed for the simple, sad reason of its postwar irrelevance. No one knows what became of it.

## Money talks

The U8 was originally planned to run under a different crossroads, Oranienplatz, but in 1926-27 it was diverted under Moritzplatz instead. This was partly because the existing buildings and infrastructure made it too difficult to go that way and partly because the head of the *Wertheim* department store wanted it to have its own direct connection to the subway to attract more customers. Most likely he was envious of the prestigious *Karstadt* store at Hermannplatz which one could access right from the train. He paid handsomely for the privilege: estimates range from five hundred to five million Goldmarks! Since such funds are, let's say, unofficial they are usually not very transparently recorded. The department store is gone today but the angry screeching of the wheels as the train rounds the resulting tight curve in the tracks still recalls that decision. The station was opened on 6 April 1928 as part of the section Schönleinstraße to Neanderstraße (today Heinrich-Heine Straße).

*Section of tunnel for a planned line that was never built. Photo Morgennebel*

This shelter is made up of twenty rooms around a 40m long section of tunnel which was part of a planned line from Moabit to Treptow that ended up never being built. Moritzplatz was to have been an interchange station and these areas should have been for passengers to transfer between lines. In their raw concrete state with the scorched walls, the effect was very eerie.

Since the groundwater level in Berlin is so high, sumps could be seen in the lowest parts of these spaces, spookily reflecting the torchlight. The entire structure is 14.3m deep, with groundwater being reached at 11.5m. Especially interesting in these spaces are the signs of their original purpose combined with the traces of the air-raid shelter.

The next room we were shown had a clear diagonal line running across the walls on two sides. Jürgen told us this had been intended as an escalator, made of wood. After the disastrous fire at London's King's Cross station in 1987 this idea was scrapped more or less Europe-wide but Sascha, having visited Budapest, told us that one is still in use in a station there. Upon closer inspection, we could indeed see traces of a staircase with an arrow pointing downwards.

*Traces of an intended escalator for passengers to transfer between lines. Photo Jonny B Kirchhain*

## Life and death decisions

In the next, very high room (4.5m), we saw a ventilation unit and gas filter made by the Draeger company on the wall with the familiar hand crank for use by the occupants of such shelters during power cuts. One of my colleagues, Manfred Gräber, spent significant amounts of his childhood sitting in the shelter in the U-Bahn station at Alexanderplatz, also on the U8 line. He tells stories of women winding those cranks until they passed out, desperate to make sure their children had enough oxygen to last out the air raid.

He and his family were even forced to leave the shelter once during one of the worst bombings of the war because there was not enough oxygen inside. Going out to face the bombs had become their best hope of survival; staying in the shelter would have been suicide. I always get a chill when I see those machines. Two-thirds of the way up the wall, we saw another one, seemingly suspended in mid-air.

Jürgen showed us other traces that proved this room had previously been divided into two floors. Out of one fairly lofty space, two very low, cramped spaces had been produced. Faded script could be seen on the walls giving the maximum occupancy of the rooms. 44 in one, 44 in the other, 103 in total.

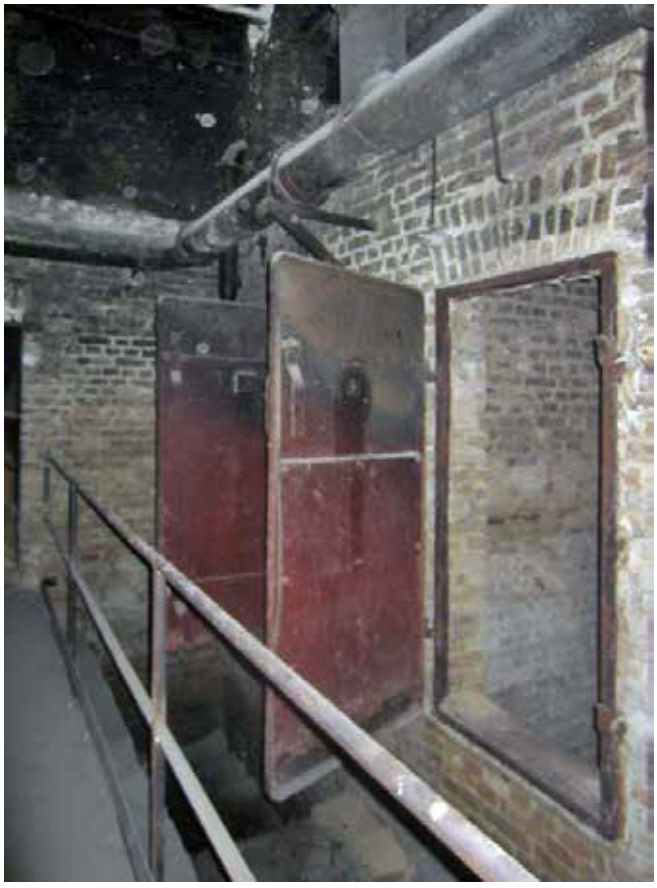
*A Draeger ventilation unit with manual crank (in the event of a power failure) halfway up the wall. Photo Andreas Steinhoff reproduced from Wikimedia Commons under creative commons licence*

*In one high level room there is evidence that it was once divided into levels. Photo Eva Westphal*

We were puzzled by this odd maths, but as Jürgen explained, it means space for 103 with ventilation, only 88 without. The dividing floor had been made of wood; although there is no way to prove this, it is probable that the floor had been taken out after the war and burned for fuel or used for repairs by the desperate Berliners in their zero hour. Being familiar with the rather more utilitarian signage in our beautifully preserved shelter


*Elaborate, beautiful script showing the capacity of the room. Photo Jonny B Kirchhain*

at Gesundbrunnen, I was charmed by the elaborate traditional German font of the signage here.
Jürgen told us that it gives us a clue as to when this space was made into a shelter. The rooms at Gesundbrunnen were completed in 1941 in a rush as part of the aforementioned "immediate programme". There was no time for frills which is why the script is plain. Therefore the Moritzplatz bunker must have been converted very early in the war at the latest. Indeed it is most likely that it was installed long before the war began. The presence of a certain kind of blast door with a peep window which is known as an earlier model suggests a construction date of 1934-5.



*Blast doors with peephole and faulty handles. Photo Jeannine Struck*

These doors were later discontinued due to an unfortunate design flaw: their handles had a tendency to fall to the open position when shaken by explosions. Not ideal for a government and populace terrified of the possibility of gas or chemical attacks such as those that occurred in WWI.

## Let there be light

We then came to a room which had formerly led to the emergency exit. With the help of a blacklight, Jürgen could show off its impressive *Leuchtfarbe* markings done in paint with a chemical compound that absorbs light and gives it back for 20 to 30 minutes - about the duration of an air raid at the start of the war.
Power cuts were of course very common during air raids so this paint was used to mark the edges of rooms, the position of door frames and any awkward corners. It allowed people to get their bearings, thereby preventing panic. In this dazzling room, numerous arrows were painted pointing to the emergency exit. Although it was expensive, it was much cheaper than installing a back-up power generator that would also have required fuel to run. The paint is still going strong even after more than eighty years.

*Leuchtfarbe markings directing occupants to the emergency exit. Photo Jonny B Kirchhain*

We then entered a high, dark room, with a strange brick wall running across it: solid halfway up and then what looked like two enormous windows of missing bricks. Jürgen challenged us to guess what they were, or what they should have been. They turned out to be leftover traces of the staircases that should have allowed passengers to transfer at Moritzplatz between the U8 and the planned Moabit-Treptow line.
Through the big ‚windows' we could see two smaller openings all the way up at the top of the room's back wall, with ventilation ducts running underneath them. Jürgen told us how on one visit an intrepid chap had climbed up, inched along those ducts and struggled into one of the openings. Emerging completely covered in soot except for his excited grin, he called down, "Jürgen, I found filters!"
Upon closer inspection, the team found traces of trapdoors and later research revealed that the heavy filter equipment had simply been transported by subway to the site and lowered into place. This was by far the dirtiest room and Jürgen said the best theory is that a *panzerfaust* (anti-tank weapon) had gone off down here at some point.
During WWII this high room had housed the shelter's command post and its infirmary. Any shelter with a capacity of 1,000 or more had to have an infirmary – not only for injured occupants to be treated but also because of the stress and intensity of an air raid having an unfortunate effect on pregnant women: it tended to make them go into labour early. We have copies of birth certificates in our archives proving that a substantial number of Berliners first drew breath in the hulking flak bunker at Humboldthain.


*Emergency exit. Photo Adelgunda Brinkmeyer*

### A penny for your thoughts

This had brought us more or less full circle. We left the way we had come in and stood, blinking in the light of the real world, with unimpressed, painfully cool Berliners streaming past us on their way out of the station and home. Only then as we stood there, dirty and exhilarated, did Jürgen pose a rather important question. Was anything missing? Was there anything we had been surprised not to find?

Since it was not usual for public air-raid shelters to store food or water, preferring instead to maximise the number of people who could fit inside, it could only be one thing: toilets. Jürgen told us it may have had dry turf toilets which were very popular and widely used in home shelters because they didn't require any plumbing. However, he told us, according to contemporary witnesses you actually had to leave the shelter and go and use the toilets in the station proper in an emergency. I suppose it was all a question of priorities.

It was a fascinating and unnerving visit which we all thoroughly enjoyed. Unfortunately the future of this particular site looks uncertain. The BVG (Berlin's public transport company) will be running necessary checks on every wall and every steel load-bearing pillar in the former shelters soon and there is a very good chance that the traces of WWII history will be wiped away in the process. This was possibly the last-ever chance to take a look inside. I was obviously very glad to be able to take part.

### See you next year

A big thank you to Sascha and Jürgen and all the *Unterwelten* team and we look forward to meeting many Sub Brit members in Berlin next May!

[**Editor's note**: as the shelter described is due for examination and renovation, it is unlikely to feature on the Sub Brit itinerary. We can, however, promise lots of other intriguing sites.]

# Spring Meeting 2019

**Saturday 27 April, commencing at 10.25am**
**at the Royal School of Mines, London SW7 2BP**

***Please note new venue – Room G20, Ground Floor, to right after Reception***
Non-members and future members are very welcome to attend.

There will be the usual mix of interesting illustrated talks along with Members' contributions and a chance to meet and mingle with fellow enthusiasts.

Confirmed to speak are Grant More from the Rotor bunker at Barnton Quarry,
Lars Hansson of Sweden's *www.bunkertours.se*
along with others yet to be confirmed on Pontefract Castle's *Key to the North* project
and the reuse of Victorian railway tunnels for high-tech aerodynamics.

Booking will be either via the website at *www.subbrit.org.uk/events*
or by post to our registered address. Please make every effort to book in advance
as latecomers make logistics and catering difficult.

**Cost for Spring Meeting is £23, to include a sandwich lunch;**
**no charge for AGM**

## Please put the date in your 2019 diary now!

# Subterranea Britannica revisits Nottingham, October 2018

**Paul W Sowan**

*Rouse's Sand Mine: one of Nottingham's larger 'caves'. Photo Nick Catford*

## Nottingham Revisited

Subterranea Britannica has long been associated with Nottingham, a city which claims to have more man-made subterranean sites than any place in Britain. In our early days our committee consisted mainly of people from Nottingham and Royston and, after a year or two also from east Surrey.

Committee meetings were often held at the offices of the City of Nottingham Museums at Brewhouse Yard and (for the lunch break) the nearby *Trip to Jerusalem* where several of the bars are in man-made 'caves' excavated into the sandstone cliff below.

In July 1978 we hosted an international symposium jointly with our sister society in France, Société Française d'Etudes des Souterrains. On that occasion, lectures were at the University of Cambridge, with visits to the Nottingham 'caves', Royston Cave and tunnels in the chalk at Chatham. One or two 'domestic' Study Weekends have also been based in the City.


*SubBrit maintains the tradition by inspecting the cellar of the 'Trip to Jerusalem'. Photo Clive Penfold*

This year we were back in the East Midlands, with a Committee Meeting at the impressive British Geological Survey headquarters at Keyworth on Friday 19 October, our Autumn Day Conference at the same location on the Saturday, and two days of visits on Sunday and Monday. Keyworth is a commuter village around six miles southeast of Nottingham city centre, with buses every fifteen minutes from the railway station.

The conference and visits were organised by Chris Gray, and featured many of the speakers, topics, and locations your scribe would have chosen. About seventy members attended the Conference on the Saturday, chaired by Committee Member Phil Catling, and fifty went on the Sunday and Monday site visits.

*SubBrit attendees at the British Geological Survey. Photo Clive Penfold*

## Autumn Day Conference at Nottingham, Saturday 20 October

### Applied Geology

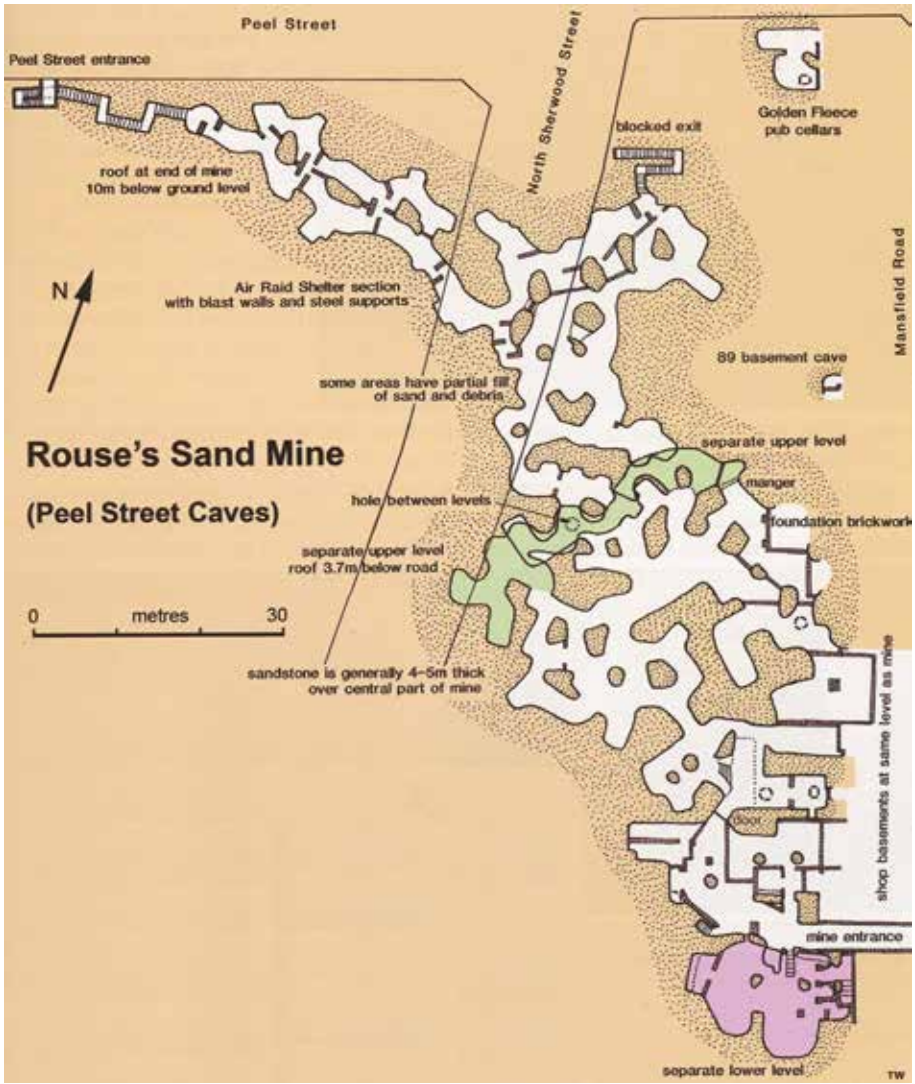
Our first speaker on the Saturday was Dr **Andrew Hughes**, who welcomed us on behalf of the British Geological Survey (BGS), a UK Government institution currently employing 673 staff including 456 professional scientists, working from the central head office at Keyworth and from offices in Northern Ireland, Scotland and Wales and one specialising in work on water at Wallingford. Much of the Survey's current work is concerned with the deeply buried geology below the British Isles, addressing questions concerning earthquakes, geothermal energy, and nuclear waste storage.

For over 180 years data have been accumulated on near-surface geology exposed in mines and quarries, road and railway cuttings and tunnels, and boreholes and wells. The Survey has an open-data policy, and most of its records relating to these questions are freely available on the Internet, including maps, books, photographs and borehole / well logs.

### Beneath the City

Second was Dr **Tony Waltham**, an acknowledged expert and author on Nottingham's 'caves', their geology and their importance. They have been variously regarded as 'heritage assets' or as 'statutory nuisances'. They are almost all man-made excavations in the Nottingham Castle Sandstone (once known to geologists as the Bunter Sandstone) constrained within the historic city limits, an area a few hundred yards across.

Many hundreds of these 'caves' are known about, although none of them are natural caves. There may be, or may have been, something like a thousand in total (Scott Lomax would enumerate these later) as new ones are found during building works, road works, and occasional collapses. A number of sites have been lost by being backfilled with concrete for ground stabilisation purposes.




*Plan of Rouse's Sand Mine (reproduced from Tony Waltham's book with permission)*

*A former sand mine in private ownership showing Victorian industrial brick foundations for a house built above and later red-brick air-raid shelter reinforcement. Photo Tim Wellburn*

The 'caves' are almost all limited in extent within building footprints, and very largely created as cellars, especially under public houses largely dating from about 1500 - 1800. Most accessible 'caves' can only be visited by special arrangement with property owners. Some have had specialised purposes such as underground germinating rooms and associated malt kilns, or tanning pits.

We were shown photographs of one 'cave' overlooking the Park deliberately created as an elaborate folly containing a carved representation of *Daniel in the Lion's Den*, created in 1837 and illustrating subsidence problems.

After his talk, Tony did a brisk trade in copies of the latest (fourth) edition of his book *Sandstone Caves of Nottingham,* which is recommended as an authoritative guide in which the geological context is accessibly presented.

## Not Nottingham

**Bob Clary** gave a brief Member's presentation on the **World War I defences in the Vosges** mountains in northeast France. A battle ensued here from June to September 1915 between the French and German armies. The Germans had built a line of substantial defences on the mountain ridge overlooking the Rhine Valley: these consisted of trenches, underground bunkers and pillboxes.

Many of them remain and can be freely viewed as one walks along the ridge from the summit of *Têtes des Faux* towards *Roche de Corbeau*. There is also the remains of an aerial ropeway which was used to bring supplies and ammunition up from the valley below on the German side. A section of the ridge further south has been cleared and turned into the *Le Linge* museum (www.linge1915.com/en), which Bob recommended.

*A Vosges hillside blockhouse and trench at the Le Linge museum. Photo Bob Clary*

## Core Store

During the lunch break Dr **Richard Shaw**, a recently retired senior scientist at the BGS (and former treasurer of Subterranea Britannica), led guided visits to the impressive **Core Store**. Here are stored, in two or three large warehouses, some miles of rock cores around three inches in diameter retrieved from deep exploratory boreholes, all meticulously documented. Most have been deposited for reference by the commercial firms that met the considerable cost of sampling rock at depths of up to a mile or more.

*A lunchtime visit to the extensive Core Store at the British Geological Survey. Photo Clive Penfold*

For a period after deposition, access is strictly limited to representatives of the originating companies. But in due course, the cores and their documentation are made generally available. The material is, in some cases, from boreholes made for primarily scientific objectives, but most are the results of investigations in connection with civil engineering works such as London's Crossrail, or with the exploration of resources such as geothermal energy and shale gas and other hydrocarbons, or the search for sites which may be suitable for the indefinite storage of nuclear waste.

## The British Geological Survey

The British Geological Survey (BGS) is the Government's official agency for the scientific recording and interpretation of rocks and minerals, mineral resources, subterranean water resources, geomorphology, landslides, earthquakes and related matters. It was established in 1835 as the Geological Survey of Great Britain (GSGB) and Museum of Practical Geology, and has always been concerned with man-made and man-used underground spaces. The Survey's accumulated records and vast output of publications are therefore essential resources for any serious understanding of such spaces.

The Survey was renamed the Institute of Geological Sciences (IGS) in 1965, and the British Geological Survey in 1984. It is often confused by non-geologists with the Geological Society of London (GSL), the professional geologists' learned society established in 1807, and with the Geologists' Association (GA) founded in 1858 as the national society for amateur geologists. Both bodies also have invaluable archives and libraries of published books and journals.

In the early days the Survey employed field geologists to make geological maps and to write detailed books of descriptions (called *Memoirs*) of the geology of the land covered by each one-inch to the mile *Ordnance Survey* map of the country. The surveying from later in the 19th century was at the scale of six inches to the mile, although most of the maps were published at the one-inch scale, the exceptions being the coal fields and the London area for which six-inch maps were published.

The hand-coloured six-inch maps as well as the surveyors' field notebooks are all publicly accessible to researchers by appointment. There is also a very large collection of exceptionally well documented photographs. Much of the Survey's resources including maps, *Memoirs*, and photographs is freely available online.

In modern times the Survey has concerned itself more with investigating deeper levels in the earth's crust using deep boreholes, seismic data, geochemical studies and so forth. It has advised the Government and commercial firms on sites, for example, for military and defensive purposes, civil engineering works, landslide and earthquake risks, shale gas exploitation ('fracking'), geothermal energy, and radioactive waste storage.

### Underground Canals …

After a buffet lunch, the **Butterley canal tunnel** on the Cromford Canal was the subject of a presentation by **David Dawson**, who described this 3,000-yard structure within the overall development of canals and canal tunnelling. The tunnel was made below the famous Butterley company's ironworks, to which it was linked by one or more vertical shafts provide to allow raw materials to be brought in and finished goods sent away by water. There are altogether some 33 shafts, most of which were spoil extraction shafts during the tunnelling.

*The east portal of Butterley Tunnel*

The canal, mostly seven feet wide, was doubled in width below the ironworks to facilitate the loading and unloading of barges. Cromford being in an important lead mining area, some water for the canal was taken from mine drainage soughs and leats.

### … and Lost Railways

**Nottingham Victoria** station and its associated railway network was the subject of **Chris Gray**'s presentation. Between 1900 and 1966 Nottingham was served by two mainline railways from London, and two main stations. The first line, of the Midland Railway, dates from the 1840s. It runs approximately east-west on the low land alongside the river Trent, on the south side of the city and is still served by its original station. The second line, of the Great Central Railway, dated from the late 1890s and ran approximately north-south, crossing over the Midland line at the eastern end of its station. The higher ground lying to the north complicated the railway's construction.

*Nottingham Victoria Station c.1903 (Disused Stations web site)*

Victoria was built on a thirteen-acre site in a cutting from which 600,000 cubic yards of sandstone was

excavated, displacing the homes of 6,000 people. The station lay between two tunnels, to which there is currently no convenient access. The bricked-up south portal of the tunnel at the north end of the station site can be seen from the adjoining car park. The station had thirteen platforms, including nine for through trains. All trains, however, had to arrive at and depart from Victoria through double-track tunnels at either end.

*The south portal of Mansfield Road tunnel, on the north side of Victoria Station, 1962. Photo Chris Ward*

Chris described the station as it was, and the run-down of services following Richard Beeching's infamous report. It closed in 1966. We were shown illustrations of the tunnels, and of fragmentary reminders of the mostly demolished station. The station itself evidently had a passenger subway linking the platforms, which might possibly survive, though presumably blocked, below the Victoria Centre shopping complex and car park which now occupies the site. Only the clock tower remains as a readily identifiable reminder of the now demolished station.

*The south portal of Thurland Street tunnel, Victoria Station, 1994. The tunnel currently accommodates steam heating pipes from Nottingham's Cattle Market waste incinerator for the Victoria flats above Victoria Shopping Centre. Photo Nick Catford*

## Water in the Bunker?

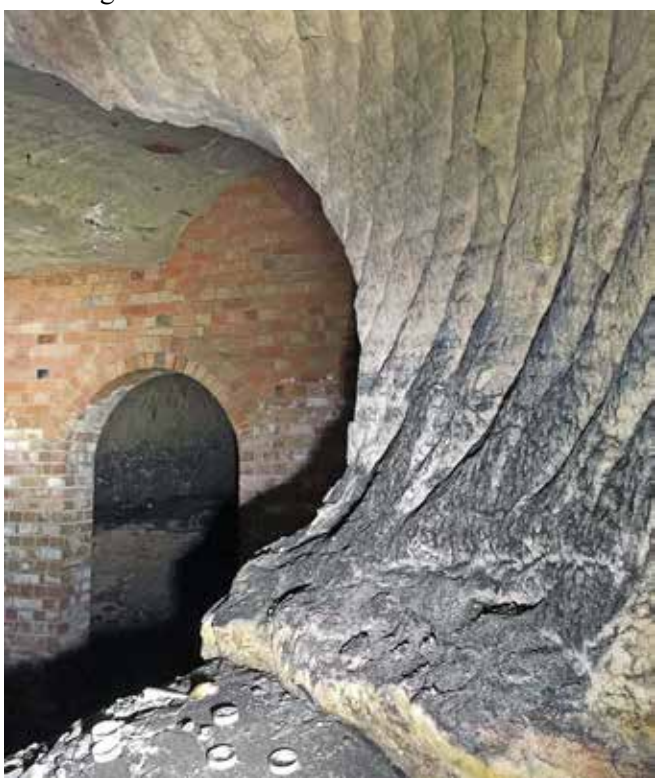
Dr **Andrew Hughes'** subject was **Groundwater and underground structures**. He spoke about England's water supplies principally from the Chalk Jurassic and Triassic aquifers.

Rising groundwater levels have been a problem in connection with the creation or use of a number of underground works, such as Warren Row (RSG 6) tunnelled into the Chalk near Henley-on-Thames. Investigation of flooding in the basement of Victoria Station (London) considered possible water sources such as groundwater in the terrace gravels in which the station stands, the culverted Westbourne or Tyburn streams, leaking sewers or water mains, heavy rainfall, or the Thames.

Other investigations were mentioned such as at the Buckingham Palace air-raid shelter, the deep air-raid shelter below Chancery Lane tube station, the Drakelow underground factory and the Anchor site at Birmingham. Creating a trouble-free underground space clearly demands an understanding of the geological and hydrological context from the points of view of water supply, flooding and drainage.

## An Enlightened Approach

The formal presentations were concluded by the City of Nottingham's archaeologist **Scott Lomax** who brought us up to date on the modern official view of **Nottingham's 'caves'** and their archaeological recording and conservation.



*Unintended sculpture in a private former sand mine. Photo Tim Wellburn*

The relatively recent creation of the post of City Archaeologist and the City's 2005 development plan reflect an official view of Nottingham's underground archaeology as 'heritage assets' rather than annoyances to be backfilled as soon as possible and unrecorded.

There are currently some 850 recorded 'caves' including those known to have been destroyed (for example by road building) or filled with concrete. At least six hundred are thought to survive, if not all currently accessible. And there may well be or have been something like 1,000

altogether. They include 36 identified underground malt kilns (a use identified by former Subterranea Britannica Committee member Alan McCormick) dating from as early as the thirteenth century.

*The art of stonemasonry in Willoughby House caves. Picture Tim Wellburn*

The forthcoming Local Plan for the City is to contain a 'Caves Policy'. Access underground should be safeguarded wherever possible. At the very least, all caves known and newly found should be 'preserved by record'. There have been 156 newly identified 'caves in the last year alone. Currently, recording is by digital 3-D laser scanning.

A few sites are statutorily protected as Scheduled Ancient Monuments. The Park Tunnel (*see below*) is to be 'listed', apparently, despite its having been excavated, not built. This was a very encouraging note on which to conclude a most interesting conference. Our thanks to Chris Gray, to BGS for the use of a splendid venue, and to all the speakers.

## An Underground Evening

Many of those present reconvened for a convivial evening meal underground at the ***Hand & Heart*** restaurant and pub in Derby Road.

This was followed by a short walk through the nearby and very impressive rock-cut **Park Tunnel**, made in the 1850s for road vehicle access between the city centre and the Duke of Newcastle's estate. It is now a public footpath and very well lit. The entrance from Derby Road, through a car park underneath an office block, is unpromising, but the lofty tunnel is well worth a visit. There is a wide shaft accommodating steps to the surface part-way through.

The lower end is, appropriately, in Tunnel Road in the Park Estate, an exclusive residential development

*SubBritters enjoy the 'Hand and Heart's 'cave' dining facility. Photo Clive Penfold*

where the street lamps are still running on gas. The tunnel slopes downwards towards the Park, and at the lower end a smaller tunnel opening of unknown purpose can be seen above the main bore. Ken Brand's booklet is recommended for details of the estate and the tunnel.

*Park Tunnel, approaching the shaft. Photo Clive Penfold*

Before the Blackwall tunnel was bored under the Thames in the 1890s there were very few road tunnels successfully completed and in use in the nineteenth century. Ralph Dodd in the 1790s proposed one under the Tyne, and started but abandoned one under the Thames near Gravesend.

The Brunels' Thames Tunnel, although intended for road vehicles, was only ever used by pedestrians until taken over by the East London Railway in the 1860s. The road tunnel started at Highgate (the Highgate Archway) collapsed in 1812 before completion. Reigate's road

tunnel (now pedestrianised) thus has a claim to being Britain's earliest successful example, opened in 1823-24. Two more were made on turnpike roads in Dorset, and there is one of the 1820s in southwest Ireland. The Park Tunnel at Nottingham is therefore a rare and significant civil engineering monument.

*Park Tunnel, viewed from Park Estate: the Derby Road access is just visible at the far end . Photo Clive Penfold*

On the way back into the city centre via Castle Boulevard those so minded stopped en route at the *Trip to Jerusalem* which, despite the claim painted on the outside, is not the oldest pub in England, or even in Nottingham. Nevertheless, glasses of locally brewed real ale were raised in one of the underground bars.

## Study Visits, Sunday 21 October

The Sunday visits were by coach to locations in Nottinghamshire outside the city. As no site notes were provided, details are from notes taken on the day supplemented from published sources including the Internet.

### Papplewick Pumping Station: a Victorian Palace of Water

At Papplewick water pumping station the subterranean interest was provided for by a guided tour of the large covered underground reservoir on a nearby hilltop. The City of Nottingham pioneered the supply of mains water flowing gravitationally from high-level covered reservoirs, pumped up from a 200ft-deep well in the underlying sandstone.

*Papplewick Pumping Station: Decorative Columns. Photo Tim Wellburn*

Papplewick was one of several City of Nottingham pumping stations with associated reservoirs, and dates from 1884. No longer in operational use by the Severn Trent water company, but more or less intact, the steam-operated pumping station is now a Scheduled Ancient Monument, and thus recognised as a Heritage Asset of national importance.

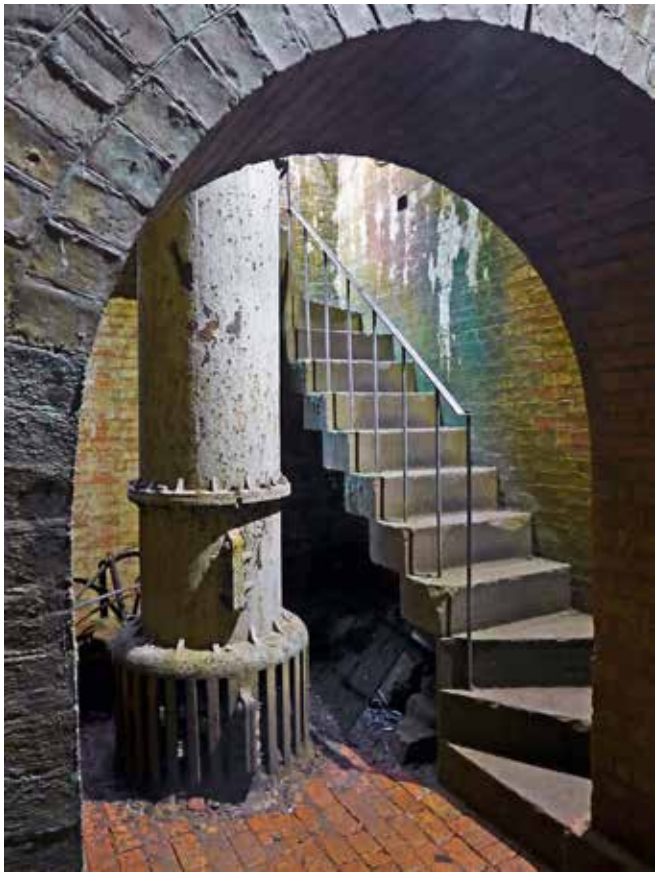
An enterprising local charity organises public open days at the site, and we were fortunate that our visit coincided with one of them. A great many people were enjoying a sunny Sunday morning and the numerous attractions. The pumping station's coal-fired boilers were fired up, and the two 1884 Boulton and Watt beam engines were operating (although not pumping water into the public supply as I understand Severn Trent now rely on remotely controlled submersible pumps).

It was a '1940s themed day' with the armed forces represented by veterans and others in service uniforms manning displays. There were miniature train rides for children, refreshment options, and all that sort of thing.

*Papplewick: The cylinder floor of the two Boulton and Watt pumping engines. Photo Clive Penfold*

After an uphill walk past fields we were welcomed at the reservoir by our guide. It has now long been out of use, and of course now contains no water. Some time ago the then owners demolished the small recorder house where water levels and flows were monitored, the resulting rubble being used to block the access underground. The Papplewick charity has purchased the site for £1 and is now spending serious money on making it accessible to visitors. The entrance has been cleared of demolition rubble and it is planned to rebuild the recorder house.

The brick-built reservoir, dating from 1879, is about 55 yards square on plan, brick-floored with a grassed roof supported by a forest of splendid brick columns. We inspected the water inlet from the pumping station, and the outlet. Also a sump provided for periodic clearing of sediment from the floor. In the first half of the twentieth century two prominent cracks in the reservoir wall were noted, and the facility was then taken out of use, water from the well being pumped to an alternative site.



*Papplewick Reservoir: Access Stairs. Photo Tim Wellburn*

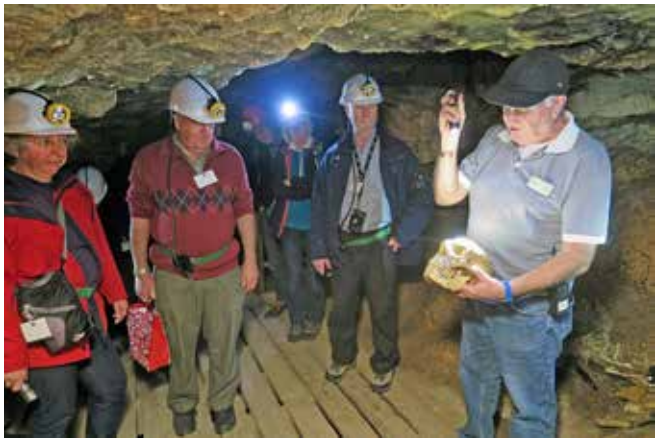
*Papplewick Reservoir: the brick columns and vaulted roof. The view shows about half of the reservoir. Photo Clive Penfold*

## Natural Caves and Folly Tunnels

Our last site visit of the day was to **Creswell Crags** and the nearby estate of **Welbeck Abbey,** made famous by the tunnelling activities of the fourth Duke of Portland. On arrival at the Crags visitor centre our timetable was adversely affected by a camper van parked blocking access to the coach park. Packed lunches were eaten in the car park.

## Creswell Crags: Ice Age Shelter

The guided tour of the Crags is through a very attractive gorge between Magnesian Limestone cliffs, one side being in Nottinghamshire, the other in Derbyshire. In both sides of the gorge there are caves formed from natural joints and crevices, with perhaps some enlargement by solution of the limestone. The site is a nationally important Site of Special Scientific Interest. Most of the caves do not go beyond daylight, but are gated and locked to safeguard the archaeology. Access underground is by guided tours.



*Creswell Caves: the guide introduces us to an earlier inhabitant. Photo Clive Penfold*

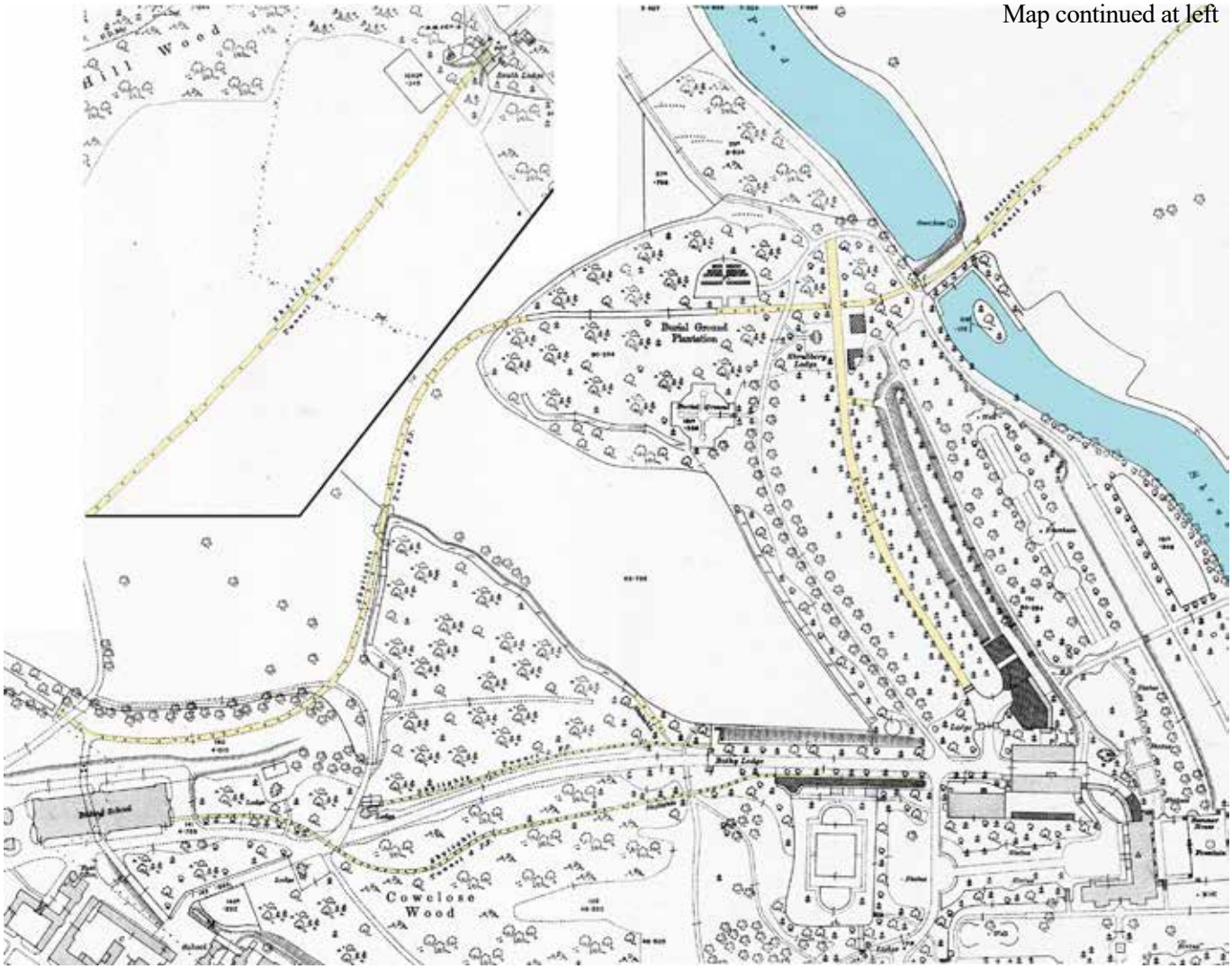
The caves were investigated archaeologically in the nineteenth century when bones and prehistoric human artefacts including flint tools were recorded from the cave floor earth. Much more recently, in 2003, very early (Ice Age) 'cave art' has been identified, and the caves are now recognised to be of international importance, occupied between 43,000 and 20,000 years BC. They represent the northernmost cave art known in Europe.

Unlike the famous cave art in France and Spain the depictions on the walls at Creswell are not painted with ochre or charcoal, but are drawings incised into the stone surfaces, so not recognised until recent times. In places, natural cracks or irregularities in the stone walls have been incorporated into the drawings of animals and the like. Examples shown to visitors range from some clearly the work of human hands to others demanding, perhaps, the 'eye of faith'. An example of 'portable art' from this site is a clear engraving of a horse's head on a large piece of bone.

*Creswell Caves: Ice Age art? Photo Clive Penfold*

The visitor centre has a café, a well-stocked books and souvenirs shop, and a small archaeological display.

Map continued at left




## Welbeck Abbey: an Eccentric Tunneler

About a mile and threequarters east of the Crags is **Welbeck Abbey**, the former home of William John Cavendish-Scott Bentinck (1800–79), the fourth Duke of Portland, generally regarded and described as a very wealthy eccentric and reclusive major landowner. He succeeded to the title in March 1854.

The *Oxford Dictionary of National Biography* records his earlier life, but provides little in detail concerning his fabled eccentricities. He served in the Army from 1818 and was a Captain of the Guards from 1830. He took his seat (as a Tory) in the House of Lords some three years after succeeding to his title. He was, also, Deputy Lieutenant of Nottinghamshire from 1859. He died in London on 6 December 1879 and is buried at Kensal Green Cemetery.

Various Internet sources, which may or may not be historically reliable, at least make entertaining reading. For example, he is said to have lived in four or five sparsely furnished rooms in a largely unfurnished mansion, and avoided contact with his numerous servants, with whom he corresponded by handwritten notes posted through a letterbox in the door to his apartments.

A trap-door in his rooms gave access via a secret staircase to cellars from which his extraordinary system of, it has been suggested, fifteen miles of tunnels radiated, linking the mansion's cellars to an underground ballroom and a chapel. Why a recluse should create a ballroom is one of a number of mysteries.

*Welbeck Abbey: the centre of the Duke's system of tunnels. Photo Clive Penfold*

Supposedly, one of his tunnels allowed him to travel unobserved in his carriage to the railway station at Worksop for trains to London. Worksop is around three miles north of the Abbey, whereas the station at Cresswell is somewhat closer. Some, at least, of the tunnels are shown on the Ordnance Survey's 25 inches to the mile plans. The 1919 OS plan is reproduced above.

*Welbeck Abbey: the eastern portal of the tunnel shown on the OS map, where it opens into a cutting on the west side of the Burial Ground Plantation. Photo Clive Penfold*

The tunnelling, reportedly incomplete at his death, is said to have employed up to 1,500 workmen and cost £100,000 per annum.

After a long walk on concrete estate roads we were able to peer into a roofless length of one of these tunnels in a patch of woodland. It had vertical, apparently brick, side-walls and was of generous proportions which might well have accommodated a horse and carriage, and had seemingly been long out of use. A little further on was more evidence in the form of capped skylights and some ventilators.

*Welbeck Abbey: Ventilators above one of the tunnels. Photo Clive Penfold*

The buildings have been used until recent years as an Army College, and are still owned by a branch of the family. The Ordnance Survey's *Explorer* map indicates an Art Centre apparently within the estate and '*Welbeck Abbey and Remains of Welbeck Abbey*', apparently distinct structures. I am not aware of any formalised arrangements for access to the tunnels.

## Study Visits, Monday 22 October

For the Monday visits sites within or near the city centre were reached, variously, by local buses, on foot, or by car. We assembled in Peel Street for a tour of **Rouse's sand mine** led by City of Nottingham archaeologist **Scott Lomax**.

### Rouse's Sand Mine

The current entrance to the mine is from Peel Street by way of a flight of concrete steps installed during World War II when part was adapted as an air-raid shelter. The mine extends about 130 metres southeastwards, from Peel Street below North Sherwood Street towards the original drift (level) entrance from which it was worked from Mansfield Road.

*Rouse's Sand Mine: Early morning sunshine at the Peel Street entrance. Photo Clive Penfold*

The plan of mined passages and pillars of rock left *in situ* to support the roof is irregular, the floor level is generally uneven, and in one area mining has been carried out on two superimposed levels: there is a hole in the floor of the upper level communicating with the lower level. Floor to ceiling heights are approximately six to nine feet, the bed of sandstone being exploited having an overall thickness of four or five feet.

*Rouse's Sand Mine: the hole in the floor between two levels of mining. Photo Tim Wellburn*

It appears that one James Rouse mined sand here from about 1785 onwards, this being one of five or six such mines in the locality. Rouse is thought to have had a level or drift entrance and used ponies to haul the sand out as there is a rock-cut feature interpreted as a manger underground. It has been suggested that the material was probably used as building-sand in mortar, on floors in lieu of carpets (perhaps especially in public houses) and for glass-making. There is an historical record for a

glass kiln having once operated in the city, where there is a road called Glasshouse Street.

There is a mention of "lily-white sand" although none matching this description was seen during our visit. The sand seemed somewhat less pebbly than seen elsewhere in the City. On account of the iron oxide content and other impurities such as clay it can only have been used for crude brown or green bottles. The ideal sand for making clear glass has even-sized and preferably angular rather than perfectly rounded pure quartz grains.

*Rouse's Sand Mine: Scott Lomax, City of Nottingham archaeologist, briefs us on fact and fiction. Photo Clive Penfold*

Late in the nineteenth century there was public guided access to this mine as a tourist attraction, with reportedly 1,000 oil lamps installed.

About the first quarter of the mine, from Peel Street to North Sherwood Street, was converted into an air-raid shelter during World War II, with a second entrance (not now in use) at the latter place. Compared with other mines so converted, such as the Chislehurst 'Caves' in chalk in southeast London, and the Reigate 'Caves' in Folkestone Sand in east Surrey, the Peel Street shelter is distinctly primitive.

*Rouse's Sand Mine: Reinforcement as an air-raid shelter, near Peel Street entrance. Photo Clive Penfold*

The uneven floor, and restricted gallery widths, seem never to have made the provision of bunks or even benches practicable. And there appears to have been no mains water supply laid on, and no provision for sanitation and drainage other than walled-off areas for lavatory buckets or the like.

Carrying buckets of water in by way of the staircases, or buckets of foul water out, cannot have been a popular job! Nottingham of course had shelter provision elsewhere in the city, including tunnelled shelters in the rock under the castle, the entrances to which can be seen alongside Castle Road.

Alongside Mansfield Road can be seen the back walls of several cellars from which, in recent years, unauthorised access has occasionally been effected.

## Cemetery Mine

From Peel Street a short walk took us to the **Cemetery Mine** and **Catacombs** on Mansfield Road where **Andrew Hughes** and a City Bereavement Service employee showed us around beyond the iron gates. At the Cemetery Mine almost all that remains accessible underground is visible through the iron gates.

As the cemetery extends above the mined area, our guide informed us that at this place one can walk below the dead as well as over their graves. The mine suffered from roof falls caused by pillar robbing resulting in the death of one Edward Hughes in 1806. Most of the rest of the roof was deliberately caved in on health and safety grounds in 1811. Graves and memorials have since been located in the spaces between the bases of the former roof support pillars.

*Cemetery Mine: The robbed pillars led to roof falls, resulting in most of the mine being untopped. Photo Clive Penfold*

## Cemetery Catacombs

Nearby in the cemetery we visited the **Catacombs**, the entrance to which is by a handsome rock-cut tunnel link (usually inaccessible beyond a locked iron gate) to a further part of the burial ground.

A little over halfway through this short tunnel an inner passageway on the left leads past two small rock-cut rooms perhaps intended to be used as family burial vaults, and then enters a space, dimly lit by a very narrow window, from which five unlined rock-cut tunnels radiate. These were evidently planned to accommodate burials, presumably in lead coffins, although this commercial enterprise came to nothing; the tunnels were left unfinished and never served their intended purpose.

*Cemetery Catacombs: Two of the five radiating burial galleries. Photo Clive Penfold*

The bunker is excavated in the alluvial deposits of the River Trent flood plain, the sandstone beds here being buried at some depth. It is on one level, located immediately below, and entered from inside, the single-storey recycling centre building. There is a very obvious ventilation shaft top outside the building.

Concrete steps lead down to a blast door beyond which is a short corridor with small rooms each side, at the end of which is a second flight of steps up, an emergency generator, air filtration equipment, the lower end of the ventilation shaft, and a vertical emergency escape ladder.

*Cemetery Catacombs: the impressive rock-cut entry tunnel. Photo Tim Wellburn*

The ends of the burial tunnels were left roughly cut and unfinished and suggest they were to have been longer. And no niches have been cut in their side-walls to hold burials such as are seen in catacombs in Paris and Kiev for example. The date of this abandoned enterprise has been identified as 1860.

## Rushcliffe Council Bunker

The last morning visit saw us at Rushcliffe Borough Council's Central Works Depot in Abbey Road, a short distance on the other side of the River Trent.

**Rushcliffe Borough Council Emergency Centre** was built in 1988 at the main council depot in Abbey Road. Nottinghamshire was quite proactive as far as emergency planning and civil defence was concerned in the late 1980s, although the County Control had limited protection being located in a semi-basement at County Hall.

Rushcliffe Borough Council was formed in 1974. It was previously West Bridgford Urban District Council; their civil defence control was in an old World War II surface blockhouse beside the council offices, which did not have a basement. Rushcliffe bunker was the only emergency centre in Nottinghamshire not located in the basement of a new or existing council office.

*Rushcliffe Emergency Centre with tell-tale ventilation shaft on the left. Photo Clive Penfold*

*Rushcliffe Emergency Centre: SubBritters determine the capacity of the emergency exit. Photo Clive Penfold*

Apart from valves to allow a slight overpressure in the bunker we noticed nothing else to suggest the purpose for which the facility was built. We saw no water supply, or arrangements for preparation of meals, sanitation or sleeping, Two or three of the small rooms were locked so not seen, although labels on their doors indicated that they were in current use as secure document stores.

The rest of the bunker evidently is now used for general storage space. The entire bunker is dry and well lit. Makers' plates on the mechanical equipment suggest this facility dates from the late 1980s, shortly before the fall of communist domination in Russia and the fragmentation of the USSR.

## Broadmarsh Caves

The last visit of the weekend was led by **Tony Waltham** to the **Broadmarsh Caves**, under the Broadmarsh shopping centre which is about to be modernised. The entrance is from the shopping mall, incongruously alongside shops at the bottom of an escalator from the Low Pavement entrance.

*Broadmarsh Caves: Dr Tony Waltham explains the history of the caves. Photo Clive Penfold*

All these 'caves' were excavated into the sandstone cliff overlooking the flood plain of the River Trent, the "Broad Marsh", and were therefore open to daylight most of the time since they were created and used. Much of the southern boundary and the ceiling comprises the modern concrete foundations of the shopping centre above them.

The more readily accessible area of 'caves' is currently commercially operated as a visitor attraction: "*The City of Caves*". Here the guides explain, for example, the wartime use of parts of the caves, and the tanning pits cut into the floor in another area.

We passed through the tourist area to a further part, to be shown where local archaeologists have removed large volumes of modern fill such as building rubble to reveal evidence for the original and primary use of these excavations.

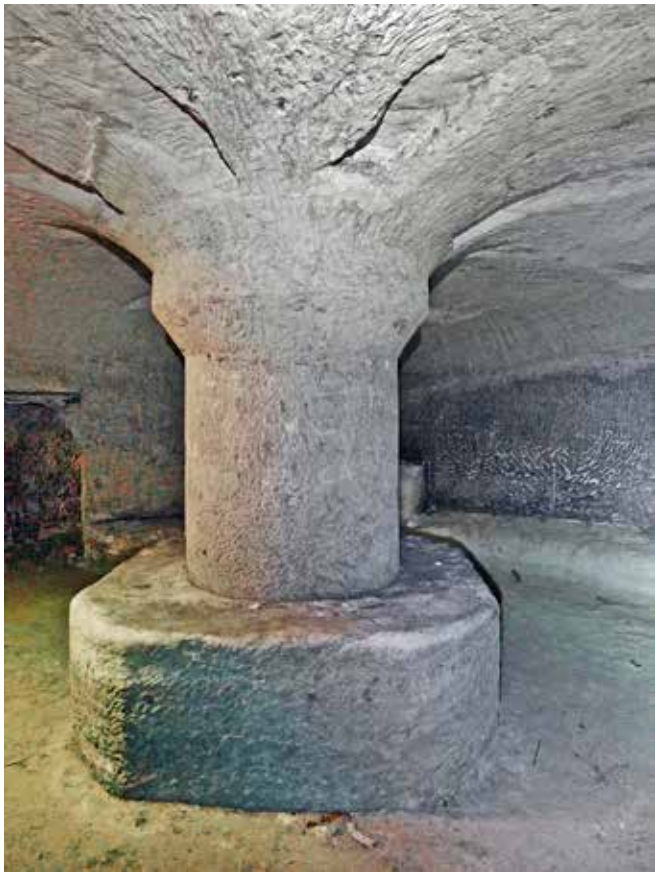
To reach this area, beyond the tourists, we exited to open air in a space quite surrounded by modern buildings where we passed an impressive mound of the excavated fill before entering the further rock-cut caves.

*Broadmarsh Caves: Tannery pits cut into the sandstone floor. Photo Clive Penfold*

The clearing of the floor of one of these has revealed this space to have been used for stabling horses. These 'off-limits' areas may in due course be used to extend the public tours, if convenient access can be created.

## Willoughby House Caves

Beyond that, and well back inside the cliff beyond the reach of daylight, we admired the three handsomely rock-cut Willoughby House caves. These are circular chambers, the largest being 7.6 metres in diameter with a peripheral stone-cut bench and a massive *in-situ* central stone pillar with, at a convenient height, a 'shelf' such as may have held eatables and drinkables.



*Willoughby House: the massive pillar in the centre of the largest of the circular cellars. Photo Tim Wellburn*

This 'cave' has been interpreted as an exclusive 'drinking den' created under the garden at the rear of Willoughby

*Willoughby House: One of the smaller of the three circular wine cellars. Photo Clive Penfold*

House, a handsome eighteenth-century mansion still standing (but now in commercial use) in Low Pavement beyond the northern limit of the shopping centre.

These beautifully cut caves are supposed to have been created under the garden at the rear of the house when it was built in 1738–41. Access was originally by way of steps down from the house, but during World War II a new tunnelled entrance was made from the cliff face for use as an air-raid shelter.

So ended a three-day programme of stimulating speakers on interesting topics, and visits to important sites many of which are not generally publicly accessible. Our thanks to Chris Gray for masterminding, and Andrew Hughes for facilitating the weekend; to the British Geological Survey for the use of their most congenial premises; to all the speakers; and in particular to Andrew Hughes, Scott Lomax and Tony Waltham who also generously gave us their time to lead visits.

## REFERENCES

As no site notes were available, the following sources for further information are suggested.

BRAND, Ken, 2009, *The Park Estate, Nottingham.* Nottingham Civic Society: 48pp [ISBN 9781-902443-11-9] [Sold at the Tourist Information Office in the city centre]

SOWAN, Paul W., 2006, Creswell Crags and Britain's first recorded cave art. *Studies in Speleology* 14, 27-32.

WALTHAM, Anthony C., 2018, *Sandstone Caves of Nottingham. Fourth edition.* Nottingham: East Midlands Geological Society: 56pp [ISBN 9780-9519717-8-9]

The Duke of Portland is the subject of an entirely fictional book: '*The Underground Man*' by Mick Jackson, published by Picador in 1997, a very readable story.

## Opportunity to join the Subterranea Production Team

We're looking for a Sub Brit member volunteer to join the team that produces *Subterranea* as a Commissioning Editor. Currently we publish three full-colour magazines a year, each with 70-80 pages.

The role is to source and commission articles for the magazine and to ensure that they are delivered with illustrations in time for sub-editing. We always try to ensure we have a good balance of articles of underground interest – of different lengths, covering various site types in the UK and overseas. Most articles are specially written but sometimes we seek permission to reprint material from other publications.

*Subterranea* is produced by a volunteer team who together take responsibility for sub-editing, proofreading, photo processing, plan production, style and layout. So you won't be on your own as this group and other members will offer suggestions of topics and potential authors to approach. We have crib sheets with advice and hints on writing articles plus a 'style guide' that can be sent to budding authors.

If you are interested in helping to keep *Subterranea* the wide-ranging quality publication it is, then in the first instance please contact our Editor, Nick Catford on nick@catford.info

# Raigmore: Inverness Emergency Bunker – Visit June 2018

**Sean L Kinnear**

*Filter units in the AC plant room. These were installed during the 1989 upgrade. Photo Nick Catford*

## 2001 Visit by Subterranea Britannica

When Sub Brit members last visited Mackintosh Road in Inverness back in 2001, the underground bunker was still in active operation as the Highland Emergency Centre. Although the Cold War had officially ended in a geopolitical sense, the interior rooms remained kitted out with a plethora of nuclear bunker kitsch.

Photos taken by Nick Catford show garishly coloured OS maps lining the operations room walls, off-white computer monitors, and the unmistakable BT plastic handsets, uniformly positioned on desks. You would be forgiven for mistaking these archive images as the fictional Sheffield Council fallout shelter, depicted in the 1984 BAFTA award-winning docudrama *Threads*. Aired on BBC Two at 9.30pm on Sunday 23 September, it was seen by an increasingly anxious British nation as a hypothetical, yet terrifying nuclear war scenario.

Thankfully, the local authority bunker at Raigmore was never utilised to organise the Highland region post-nuclear attack, or deal with casualties suffering from radiation sickness during a nuclear winter. Raigmore rather operated in a different capacity, managing responses to major peacetime emergencies within Scotland.

Fast forward to 2018 and the subterranean bunker is in the process of being sold on the open property market. The nature of reuse with this unique architectural typology suggests a potential new tenant could have sensitive or highly confidential proposals in mind, possibly closing the blast doors to the public indefinitely. With an unknown future ahead, I had to get in and have a look before the legal missives had been completed, and the keys handed over.

## The scene in 2018

The scene down inside the bunker now is one of emptiness.

The various cellular rooms across the two-storey, semi-sunken structure have been stripped of anything that wasn't screwed to the floor, ready for a formal handover.

The walls have been returned to their blank canvas, handsets and computers removed, maps taken off the tote

*Council office, stripped of furnishings in 2018*

*Communications centre in 2001. Photo Nick Catford*

*Communications centre in 2018, now stripped of loose furnishings and wall maps*

boards, and task chairs wheeled away. The underground bunker once fully prepped for a nuclear Armageddon has essentially been reduced to a carcass, relinquished of that powerful and eerie Cold War character.

Advertised for sale in November 2017, with a closing date for offers by December, the bunker has reportedly experienced high levels of interest from various third parties. Aside from some peeling paintwork internally needing attention, and the carpets requiring a good hoover, the interiors of the subterranean space are in remarkable condition considering its over 75 years old!

*Operations room in 2001. Photo Nick Catford*

*Operations room on lower level used until 2016 as part of the Highland Emergency Centre. The control room has been cleared in preparation for the bunker sale*

*View of upper level corridor. In situ reinforced concrete roof is exposed at high level*

Being a renovated Filter Block, part of the World War II RAF Sector Operations Centre (SOC), this bunker astonishingly looks ‘move in ready’.

*View of upper corridor showing ceiling mounted ventilation ducts and exposed in-situ concrete roof at high level*

As it's connected to mains electricity, water and drainage, it isn't difficult to imagine the prospective buyer repurposing the bunker into something quirky. Music recording studios, hotels and data centres have all become popular adaptations for similar bunkers across the globe.

Cultybraggan Regional Government Headquarters, outside Comrie in Perthshire, is a prime example. Purchased by Bogons Ltd back in 2014, the semi-sunken decommissioned bunker is now home to an impressively growing data centre of the future.

Up in Raigmore, there seems little cosmetic work required in a renovation sense. This is primarily due to the fact that the Highland Council adopted the structure back in 1961, permitting essential repair, upkeep and maintenance when necessary. Unlike many other nuclear bunkers dispersed across the landscape, Raigmore bunker benefits from being one of the handful of Cold War relics registered in Scotland as a listed building, offering its architecture a degree of legislated protection.

Awarded Category B status in 2002, Raigmore shares its mantle with the likes of Viewmount Council Emergency Bunker in Stonehaven (Category C) and the Civil Defence Group Control at Tertowie House in Aberdeen (Category B). Detailed listing entries can be found for Raigmore and other Cold War sites of interest through the Historic Environment Scotland (HES) portal.

The Canmore archives, situated at HES offices in John Sinclair House in Edinburgh, also hold fantastic black and white photographs of the Raigmore Estate. Wartime aerial shots and an assortment of stills taken from the bunkers in 1991 are some of the material available.

## Location and setting

The approach to the bunker is intriguing, a certain kind of revelation to the visitor. Firstly, for those who haven't yet had the pleasure of experiencing the Raigmore site, you are not in a remote location, or concealed within a landscaped formation. You are in the middle of an Inverness residential housing estate with minor camouflage offered in the way of trees and shrubbery.

If arriving from the direction of the train station, your final leg of the journey includes passing a local Scotmid store before turning into Mackintosh Road. After a short walk past a mixture of housing developments and bungalows you are greeted by a chain-link fence topped with barbed wire, a padlocked gate and a distinct radio mast reaching skywards above a tarmac car park.

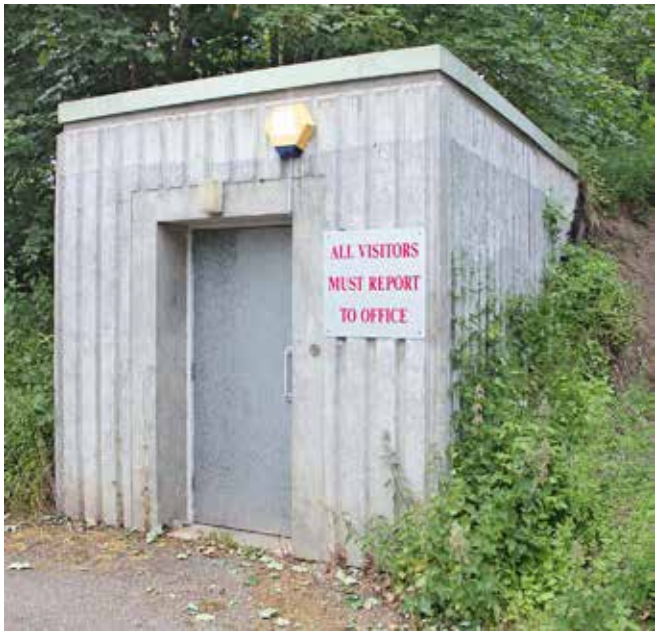
*Exterior view of site. The 1980s portacabin can be seen to the left of the image. This was the main base for staff stationed here until 2016*

Peering through the fence you can make out what appears to be the entrance to the bunker, protruding from the earth mound to the rear of the site; between the surface-level Portacabin office and the latticed radio mast.

*The 1980s constructed entrance can be seen extruding out of the grass mound. The portacabin offices are out of shot to the left and the radio mast can be seen on the right of the image*

Unlike the earlier ROTOR bunkers of the 1950s, there is no concealed access via a decoy guardhouse constructed in the local vernacular style. Instead, a metal door is set within a poured concrete entrance that reminds me of the hatches featured in the post-apocalyptic Danish series titled *The Rain*.

Upon closer inspection my architectural eye identifies the distinct pattern of the shuttering used in constructing the in-situ concrete surface structure. There's even a doorbell insert within the frame next to the sign that reads "All visitors must report to office".



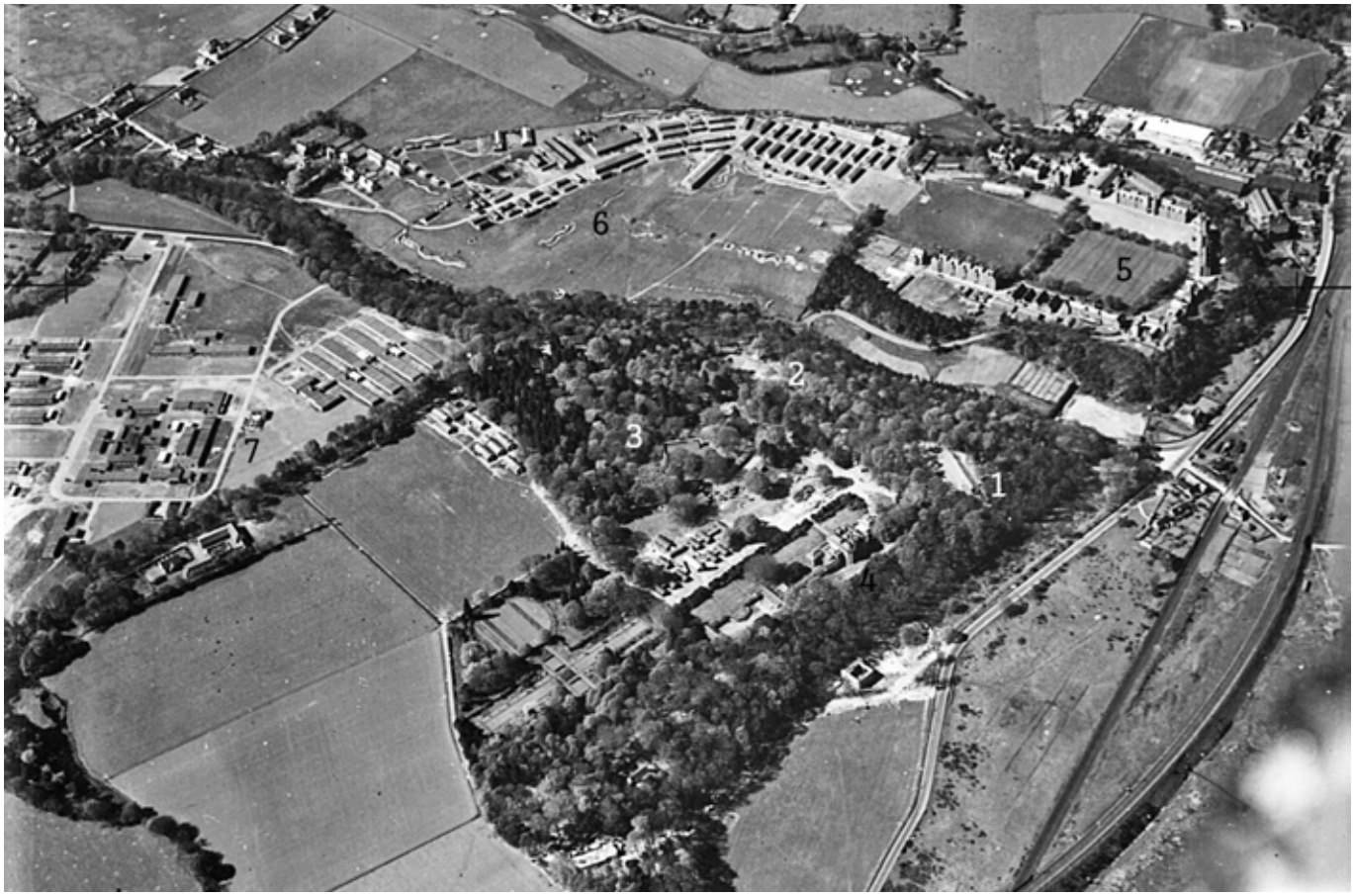

*External view of main entrance from car park. In-situ concrete extrusion with vertical shuttering relief was part of the 1980s bunker alterations*

This current setting certainly provokes a sense of paradox. However, researching the history of the Raigmore estate it became apparent that this area had previously existed with a strong Air Ministry, Civil Defence and Royal Observer Corps (ROC) presence.

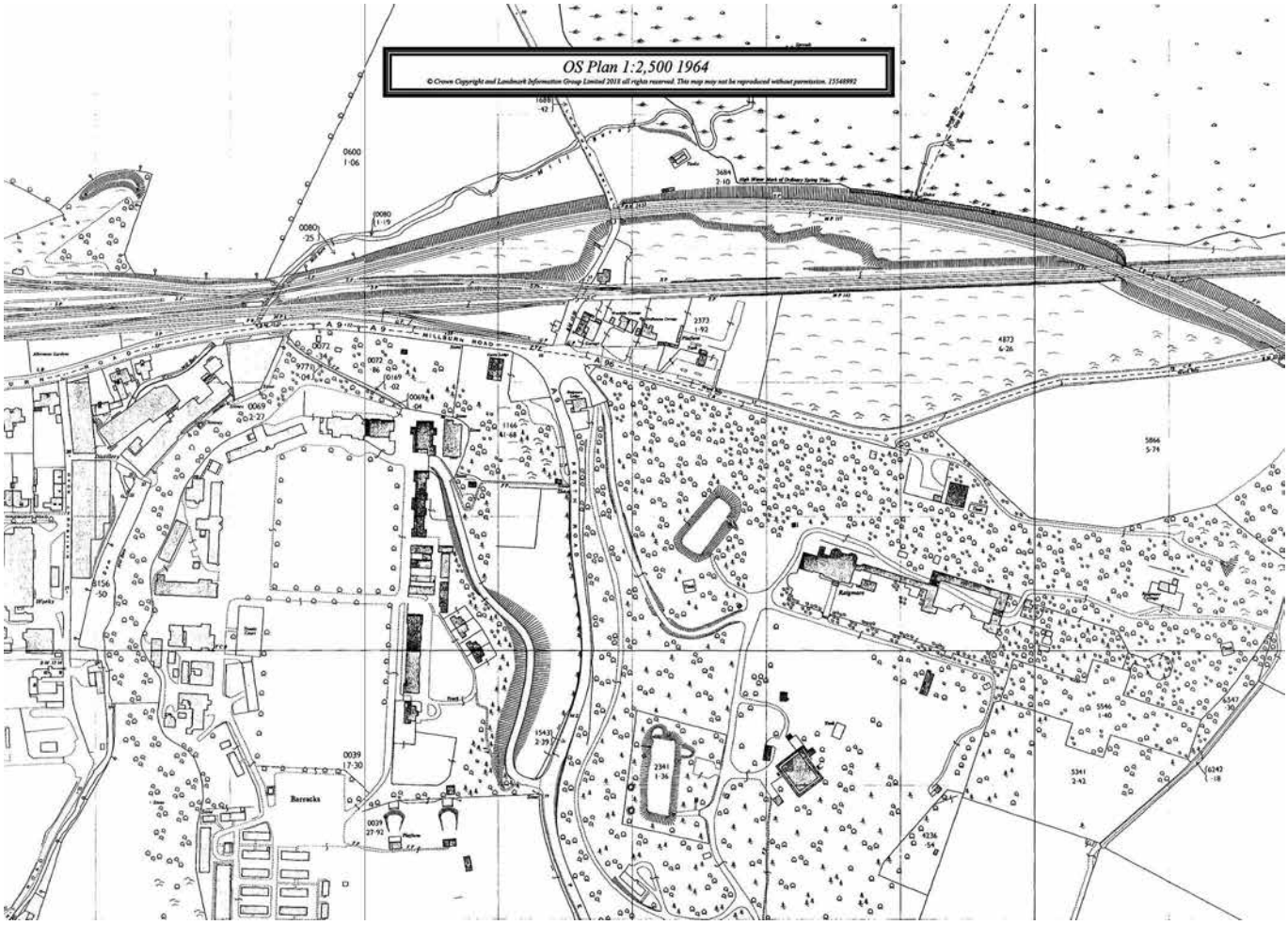
## Bunker history

Dating back to the 1940s, the 35-acre Raigmore Estate was under the ownership of the Air Ministry. The original WWII Sector Operations Centre was comprised of three separate bunkers: an operations block, a filter block and a communications block. The filter block, now the Highland Emergency Centre, is the only survivor today as the others have been demolished.

*External view of emergency exit from car park level. Door was part of the original WWII SOC bunker*




*RAF WWII oblique air photograph (1942) looking South west: The original WWII filter bunker, latterly known as the Highland Emergency Centre (1), can be seen west of Raigmore House (4). To the southwest, the now demolished ROC Group HQ No.30 bunker (2) situated on King Duncan's Road and the WWII communications bunker opposite. Cameron barracks (5) lies to the west of the bunker line with practice trenches visible (6) and the old Raigmore military hospital (7) is in partial view to the southeast. Reproduced under licence from Historic Environment Scotland*




*Map - OS Map 1964 Showing Raigmore Estate. From* www.old-maps.co.uk

The nearby operations block on King Duncan's Road was home to ROC Group HQ No 30 before being demolished in the 1990s.

Raigmore House itself was razed around 1961 and the land is now occupied by the new hospital extensions and housing scheme units. Aerial photographs taken during WWII show an unrecognisable scene: what were then military landmarks hidden within a thick treeline have been replaced by two- and three-storey social housing blocks.

Archive files document this changing of the guard when the site was initially disposed of by the Air Ministry in 1961. The Highland County and Burgh Council co-operated in a combined bid to acquire the Raigmore Estate lands and premises. Declassified documents allude to fluctuating plans, including retaining two of the wartime SOC bunkers for Civil Defence purposes – the filter block being designated as the new HQ for Group and Deputy Zone Control. An area of surrounding land, along with Raigmore House itself, was pencilled in for Civil Defence training zones but was eventually deemed unfeasible within the Highland Council development plans.

The Raigmore bunker immediately underwent internal alterations to become operational, almost fully funded by the Civil Defence Grant (Scotland). A vinyl floor was installed along with a new telephone switchboard and accompanying lines. The bunker was also intricately furnished before being ready to house the new Civil Defence tenants, present from 1961-68.

When the Cold War heated up again politically under the Thatcher administration, there was a notable resurgence in Civil Defence emphasis across the nation. The late 1980s saw an upgrade to the Raigmore bunker that included a new air-filtration system, water storage tank and modernised blast doors to cope with potential nuclear and biological attacks.

*Ventilation stack; slowly being consumed by the overgrowth*

Newly established as the designated Highland Council Emergency Centre, the bunker would see active use

in peacetime scenarios until its final decommissioning around 2016.

### 1989-91 Upgrade

Having visited a number of these structures across Scotland and England, as well as religiously viewing the Sub Brit site records, I have a personal affinity in uncovering something different with every Cold War bunker I visit. The modular nature of the government's bunker programme in Britain from 1949 to the 1990s has undeniably resulted in the notion that these structures have all been built to similar or near-identical designs. At Raigmore, I recognise the standard off-the-shelf Friedland alarm bells and MEM fuse boxes present at the likes of Troywood bunker in Anstruther and the Cambridge War Room.

*View of lower level corridor showing exposed ventilation and electrical services*

The decontamination showers at the bottom of the entrance stairs also look similar to those extant at Cultybraggan.

However, what struck me here is the impressive blast doors positioned at the main entrance, plant room and secondary escape route. These solid doors are unlike anything I've seen to date and possess an impressive weight and mass. Serving as a testament to their endurance, they are still in magnificent condition; the rubber air-seals around the jambs still look capable of shielding radioactive fallout and biological hazards today.

My guide for the visit was Chris Holmes, who is dealing with the disposal of the bunker for the Council. Chris asked if I would like the chance of closing and sealing one of these doors; as if I were hypothetically hunkering down pre-attack. I gladly jumped at the opportunity and can safely say – these blast doors are extremely sturdy!

I was also lucky enough to see a demonstration of the plant machinery being switched on. The air filtration system, which was part of the 1989-91 upgrade, is still in perfect working order and kicks in with a monstrous noise. Those two fixed road bikes for manual back-up in the event of power failure are still there, virtually unblemished as seen in Nick Catford's 2001 photographs.


*Interior view of reinforced concrete blast door at main entrance*


*Reinforced concrete blast door leading to decontamination showers located on the upper level*


*Interior view of emergency escape at upper level. One of the many reinforced concrete blast doors surviving in fantastic condition*

*Ventilation and air filtration plant room with mounted bicycles for use in the event of power failure. Virtually unscathed since Nick Catford's photographs of 2001*

Like most plant rooms I've been in during my architectural career, the Raigmore bunker equipment appears in similar fashion. The operations and maintenance (O & M) manuals are carefully stored on shelves, complete with supplementary technical drawings and schematics for the services.

The Highland Archive Centre in Inverness retains a fantastic collection of documents from the upgrade works. The level of detail in the architectural and structural hand drawings surpassed my expectations. The original planning, building warrant applications and construction contract depict a unique architectural brief.

## Recent Use

Before the bunker was placed on the disposal list it had still been actively used up until two years ago. I was told by Andrew Denovan, the Emergency Planning Officer stationed here from 2001 until 2016, that the site on Mackintosh Road was base camp for the Highland Council's Emergency planning unit. Events such as the foot and mouth disease outbreak in 2001, the major Highland winter storm of 2005 and Dingwall floods in 2006 were all monitored by the specialist unit who planned and co-ordinated support from the underground bunker.

Andrew recalls the operations room as the central hub of activity during such incidents. The large square desk in the middle of the room, as shown in Nick's 2001 photos, is still present in 2018. This acted as the cockpit for representatives of each council service that had been summoned to deal with the scenario at hand. The surrounding walls were filled with tote boards populated with situation reports and current information on the incident's details, resources and staffing.

*View from main entrance looking down access stairs. This connection was formed as part of the 1980's alterations*

A large map of the Highland area was constantly updated by the radio handlers and switchboard operators, based on the data fed into the bunker. During such events a team of dedicated volunteers from the council provided administration support while staff welfare was maintained with access to the kitchen facilities.

Outwith these rare emergencies, the Raigmore bunker was essentially another facility for the use of the Council. With video conferencing and digital projection capabilities, the bunker was ideal for meetings and training exercises.

Some of the staff stationed here experienced a disconnect from the natural and familiar surface-level environment when working underground. This is described by Andrew as a feeling of the senses being 'shocked' when emerging into the wind or sunshine after being underground in a steady, cool temperature with no exposure to external noise.

*Interior view of access stairs looking towards main blast door at surface level. Stairs were constructed as part of the 1980's bunker alterations*

Andrew does however recall that the idea of subterranean life in the bunker was too much for some Council staff, who cited reasons of claustrophobia, headaches and fear of stale air as worries. In recent years, the Council also conducted tours for groups of local schoolchildren to educate them on local Cold War history. This imagination encapsulating structure has also attracted the attention of the Glasgow Paranormal Investigations team who spent a night in the bunker a few years back.

However, in 2017 the Council announced the facility as surplus to requirements, a phrase too often associated with these fascinating structures left over from a significant, yet sometimes forgotten period of our history. With business rates in the region of £20,000 per year, expensive utilities and maintenance bills, the bunker was designated for disposal.

## What's next?

With the legal administration still underway pertaining to the sale of the bunker, we can only speculate to what the future holds for Raigmore. Thankfully, given the protection from listed building status, there will be no immediate works conducted that threaten the character of this unique structure. Conceived in WWII, adapted and reused during the Cold War and occupied right up into the 21st century, it is safe to say this bunker has stood the test of time.

I'm sure we all share the hope that the life of Raigmore continues, whilst being well looked after and maintained for years to come. For myself this was another small mission accomplished on my journey to visit and document the remaining Cold War bunker sites existing across the Scottish landscape.


## Acknowledgments

I would like to thank Chris Holmes and Andrew Denovan, both of the Highland Council, for their assistance in visiting Raigmore bunker and answering my countless questions around its Cold War history.


## Sources


*Cold War Bunkers* - Nick Catford

National Records of Scotland, Edinburgh - HH51/201, HH51/123, HH51/76, HH51/70

Highland Archive Centre, Inverness

Photos by Sean Kinnear unless stated


# Subterranea Britannica

# Notice of Annual General Meeting 2019

**The AGM will be held on Saturday 27 April 2019 at 10.00am**
**at the Royal School of Mines, London SW7 2BP**
**in association with the Spring Meeting**

***Please note new venue – Room G20, Ground Floor, to right after Reception***

Attendance is open to all current members of Subterranea Britannica.

Documents for the AGM will be available on our website at *www.subbrit.org.uk* at least 28 days in advance of the meeting; an email will be sent to advise this. Documents will be sent to those members who have registered to receive them by post.

Minutes of the AGM 2018 were printed in *Subterranea* 48, August 2018.

# Tunnelling on the Oxted line, East Surrey: 1865-67 and 1880-84

**Paul W Sowan**

*Interior of tunnel showing the double curvature. The radius of the curves is probably exaggerated in the photograph*

## Introduction

The almost nine miles of railway line from South Croydon Junction, on the London to Brighton main line, to Oxted, a small town in east Surrey, presents a number of points of historical interest, most obviously the 2,266-yards Oxted tunnel which is relentlessly curved throughout. This appears to be the only long British tunnel, of over a mile, so constructed.

The possible reasons for this feature are discussed, and one or two plausible answers are suggested. In the course of this research, several further questions are raised concerning practical aspects of the tunnelling methods employed, which call for further thought.

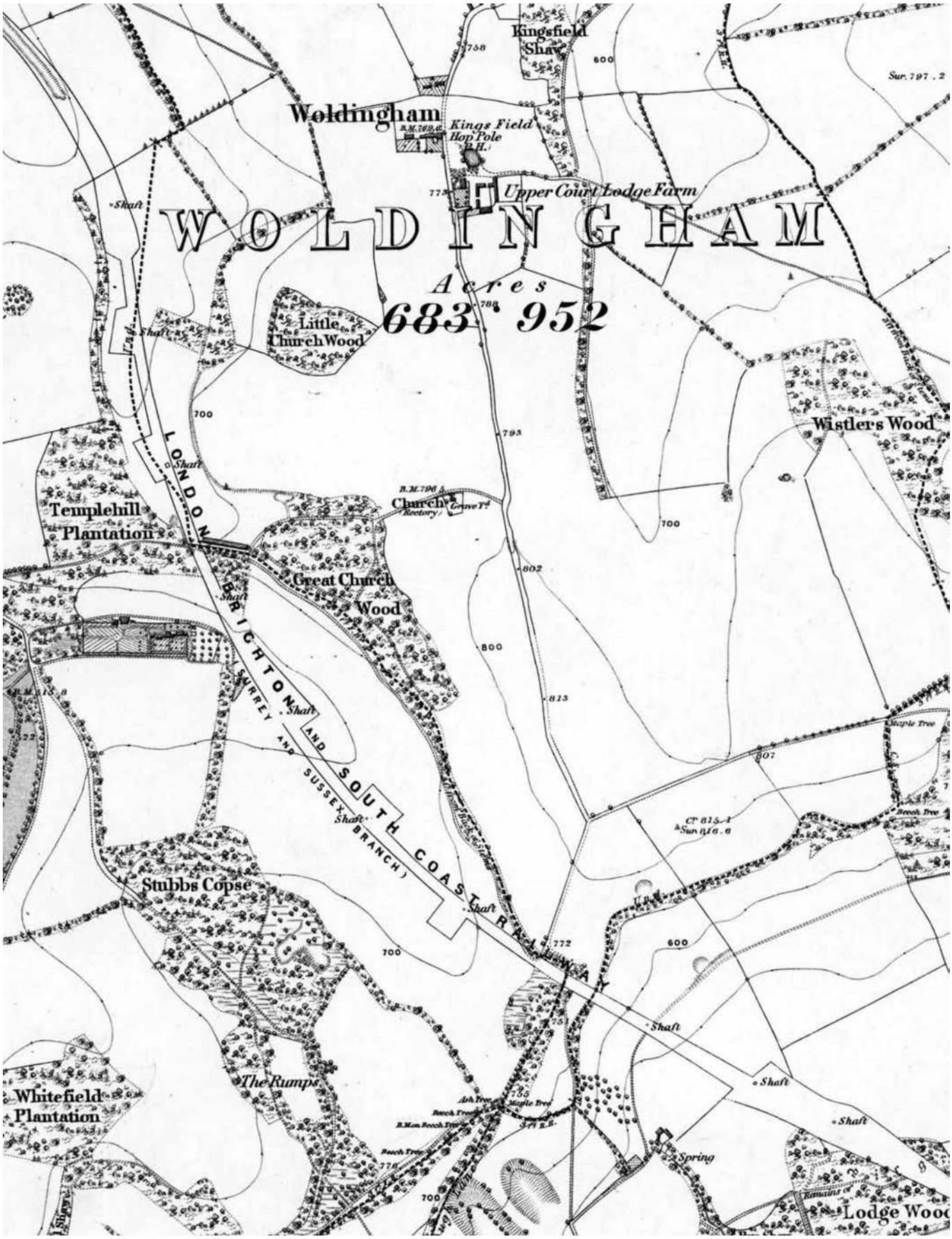
Two published histories of the line have been studied, one a revised updated version of the other, but are unsatisfactory insofar as the planning and construction of the line are concerned, and also contain a number of factual errors. The line as built features two tunnels, at Riddlesdown (836 yards) and Oxted (2,266 yards). Temporary tunnels were also created in forming open cuttings.

## The line described

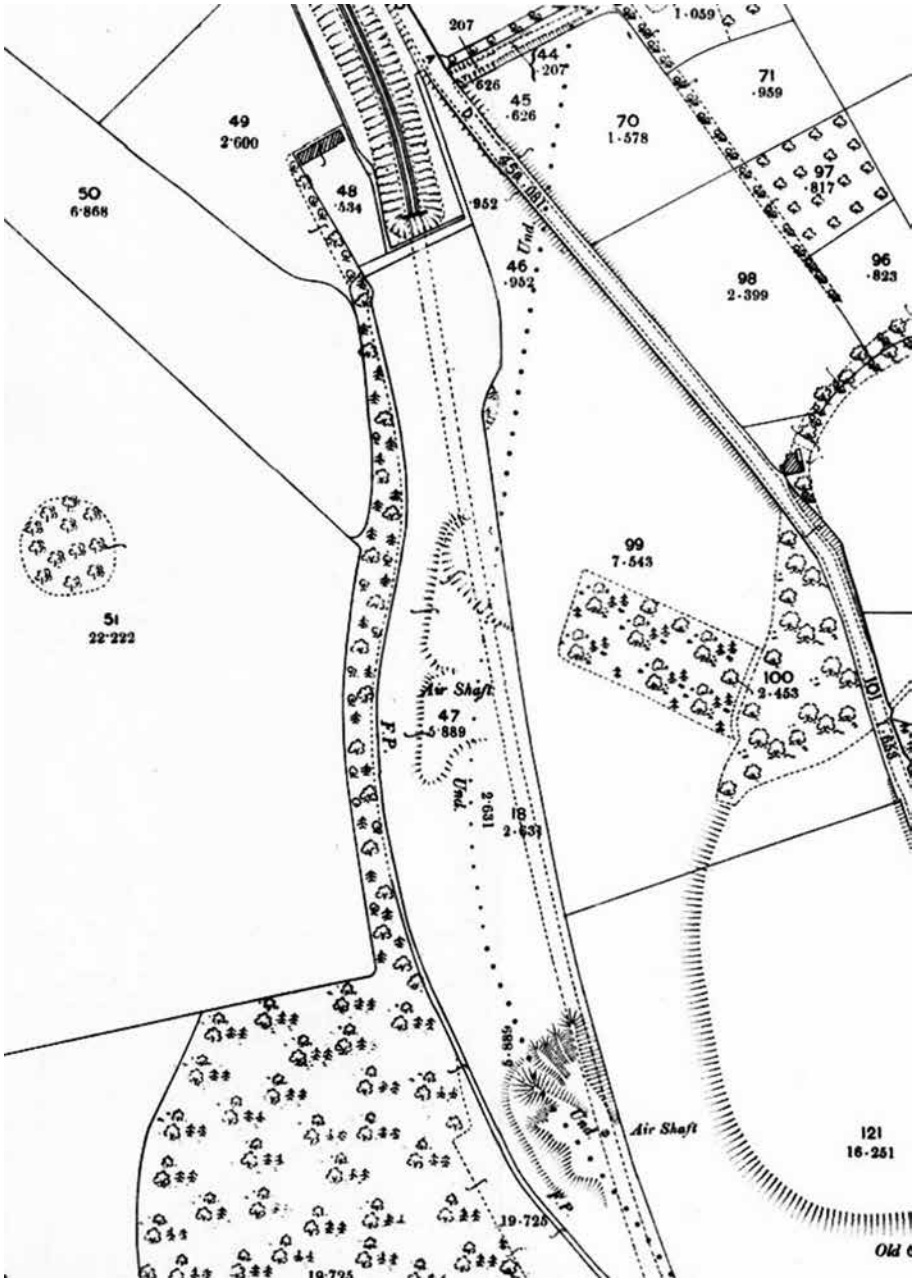
From South Croydon Junction on the Brighton line (opened in 1841) the Oxted line (double-track throughout) branches off to the east on a rising gradient, passing the abandoned platforms of Selsdon Station (closed in 1983) at 30 chains. Sanderstead station (74 chains) and Riddlesdown station (two miles 9 chains) are passed before Riddlesdown tunnel (836 yards) and then a viaduct over a large disused chalk pit at Kenley, beyond which the line passes from the London Borough of Croydon into the Administrative County of Surrey.

After Upper Warlingham station (four miles 4 chains) and Woldingham station (five miles 66 chains) the line summit is passed. The descending gradient through the Oxted tunnel continues to Oxted station (eight miles 76 chains). With the exception of Oxted, all the preceding stations are not located conveniently for the villages they were supposedly to serve. Selsdon, Sanderstead, Warlingham and Woldingham village centres are all up on the higher ground a mile or so to the east of the line.

Some stations, especially Oxted, have developed their




*The first edition of the 6 inch Ordnance Survey large-scale map (published 1972) was surveyed after Messrs. Warings had abandoned work on the line in 1867 and before Joseph Firbank recommenced work in 1880. The permanent shafts had all been commenced, and rectangular area had been designated for the dumping of chalk excavated in forming the tunnel. However, insufficient tunnelling had been done to form spoil banks considered large enough to be mapped by the surveyors. The tunnel spoil tips are shown on the second-edition map of the 1890s. Several temporary shafts are indicated beyond both portals. They were destroyed when the approach cuttings and final portals were made. Note also the position of Great Church Wood*




*The second edition of the Ordnance Survey's 25 inches to the mile map (Surrey XXVII.3/4 -1896) shows the northern part of the Oxted tunnel route as completed. The spoil is chalk excavated in making the tunnel. Temporary shafts at the north and south ends were lost in digging the approach cuttings and forming the portals*

own built-up localities and commercial centres. The old Oxted village centre is now a tiny place by-passed by the A25 main road some distance to the west of the modern town centre and station.

With the exception of the last mile and a bit from the south portal of the tunnel to Oxted station, the line traverses hilly chalk country, with very heavy civil engineering work throughout. There are two tunnels, 17 embankments and 21 cuttings. At no point is the line on perfectly flat and level ground, making this a remarkably expensive line to build.

## The history of the line's development

The Oxted tunnel is the second of the two long tunnels through the North Downs chalk in Surrey. In the late 1830s the London & Brighton Railway Company built its main line to the coast, opened in 1841. This (still in use) includes the first Merstham tunnel of 1830 yards through the chalk, between Coulsdon South and Merstham stations. This was a seriously purposeful line taking the shortest and most direct line from London to the south coast.

The engineering merits of this line, and Stephenson's alternative longer route by way of the Mole Valley between Leatherhead and Dorking, avoiding the need for a long tunnel, were debated at length by a Parliamentary Committee, the minutes of which were published in 1836.

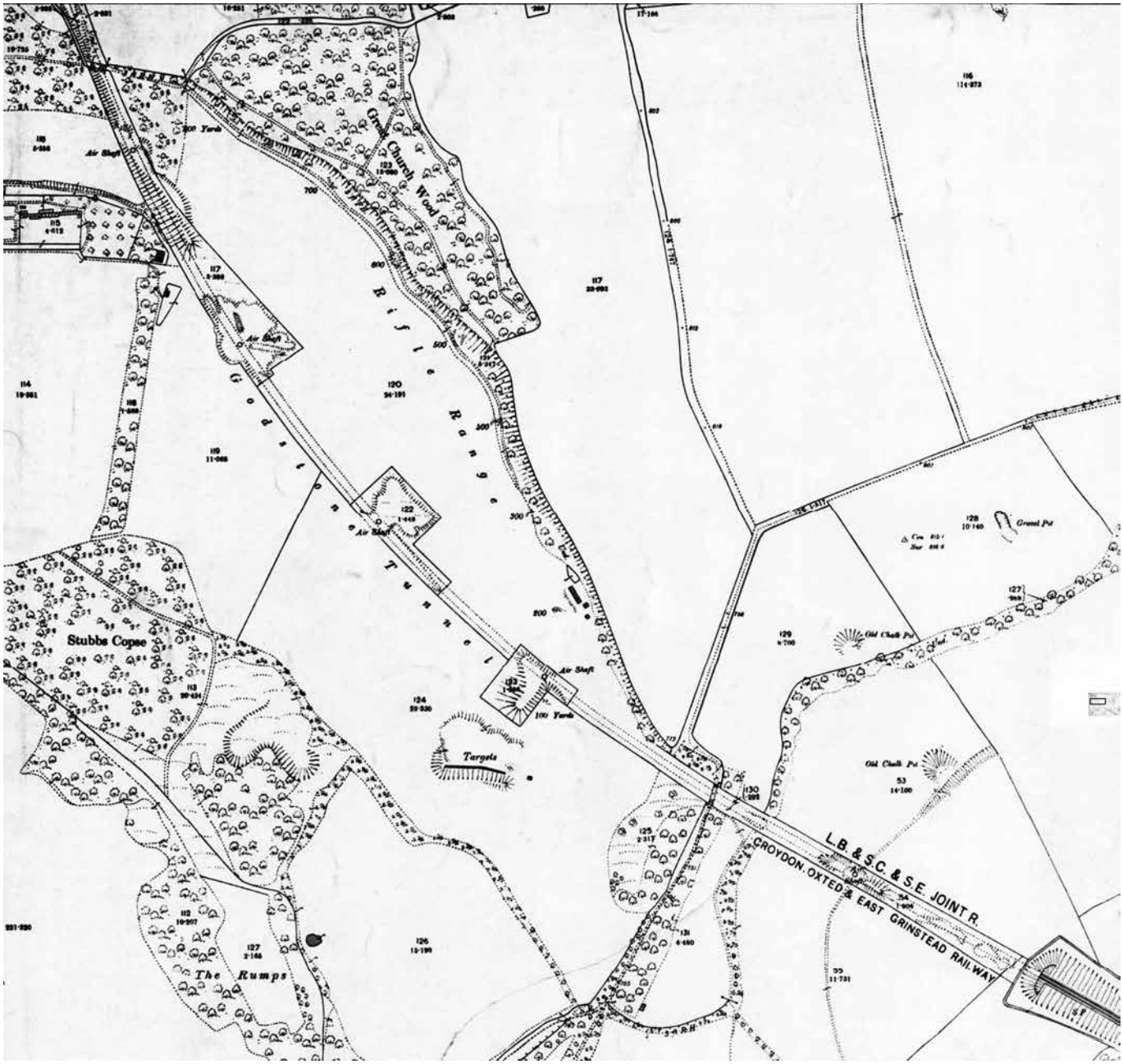
Curiously, the arguments for and against a tunnel at Merstham made no mention of the problems that might arise from groundwater in the North Downs. In the event, the as yet unfinished Merstham tunnel workings were seriously delayed by groundwater flooding in March 1840 although, contrary to statements in some modern 'histories' of the Brighton line, the death of Henry Hoof, the contractor making the tunnel, had nothing to do with this flooding or with ancient underground quarry tunnels.

It might be expected that experience gained in tunnelling through the chalk at Merstham might have been taken into account in planning the Oxted tunnel in the early 1860s, although there is reason to doubt that it was.

More or less at the same time as the Brighton company's line was being debated in Parliament, the South Eastern Railway Company proposed the first main line from London to Dover for ferry connections to France. This company's line was at first proposed to follow the route later taken by the Oxted line, at least as far as Oxted, and indeed some tunnelling is recorded to have been commenced under Riddlesdown.

It would have made logistical and economic sense to have commenced work on the longer tunnel first, although I have seen no evidence to suggest that this was the case. However, Parliament decreed that the South Eastern company's trains should follow the Brighton company's lines as far as Redhill before turning east towards Tonbridge and Dover. Tunnelling at Riddlesdown was therefore abandoned.

Whether, as is possible, shafts sunk in connection with this 1830s tunnelling were utilised in the creation of the




*The second edition of the Ordnance Survey's 25 inches to the mile map (Surrey XXVII.8 - 1896) shows the southern part of the Oxted tunnel route as completed including shafts 3 to 6 and their associated spoil banks. The spoil is chalk excavated in making the tunnel. Temporary shafts at the north and south ends were lost in digging the approach cuttings and forming the portals*

completed Riddlesdown tunnel in the 1860s appears not to have been recorded. If not, there may be a sealed and abandoned tunnel in this locality awaiting rediscovery.

Nevertheless, the results of surveying for the abandoned route to Dover might, if available and consulted, have been of value to the planners of the Oxted line as built in 1865-67 and 1880-84. Whether this was done or not I have yet to ascertain.

In the early 1850s a branch line was planned and built from Purley, on the Brighton line, to a terminus opened in 1856 near, but not at, the small hilltop village of Caterham. The village (now known as Caterham-on-the-Hill) is at the top of a steep hill from the station, around which the commercial and residential centre of Caterham-in-the-Valley has subsequently developed.

Jeoffrey Spence's excellent history of *The Caterham Railway* chronicles early railway development in east Surrey and, of interest for the purposes of this article, unimplemented proposals for extensions southwards towards Godstone, on the far side of the North Downs. Extending the line southwards from Caterham through a relatively short tunnel at shallow depth passing through the Godstone Gap to Godstone would have been a much cheaper option than the Oxted line as built and described in this article.

## The Surrey & Sussex Junction Railway (SSJR) 1865-67

The line from Croydon to Oxted, as built, commenced as the northern part of an intended line to or near Groombridge in the Kentish Weald, where there would have been (and later were) junctions to several other rural

*View up one of the shafts. The internal diameter appears to be about nine feet. Almost all chalk dug out to make the tunnel was lifted up these shafts and tipped beside the shaft tops. Everything needed to dig and line the tunnel and shafts was lowered down this way, including tools, temporary rails, waggons, haulage animals, candles or oil lamps, gunpowder, bricks and mortar. And floodwater was bailed or pumped up this way. The shafts, also,were the way to and from work for the tunnellers*

branch lines offering connections to, *inter alia*, Tunbridge Wells and several places in east Surrey and west Kent. This was not planned as a purposeful main line to any major destination.

The Surrey & Sussex Junction Railway company, authorised in 1865, appointed the Waring family partnership as contractors to build the line, and had made considerable progress with earthworks and tunnelling until the celebrated Overend Gurney bank failure of 1866. All work ceased in early 1867, leaving some miles of abandoned cuttings and embankments, and two unfinished tunnels in the landscape, although the company continued to exist only 'on paper' until formally wound up.

By good fortune, the line as abandoned was surveyed for the Ordnance Survey's first 25 inches to the mile plans shortly after work was terminated. And also, the abandoned earthworks were examined and described in print in some detail by geologist Caleb Evans.

*South portal of Oxted tunnel*

Although Evans' main concerns were the stratigraphy and palaeontology of the Chalk, his published booklet contains a valuable 'snapshot' of a partly-built railway which throws considerable light on how the Waring brothers did the work.

## The Croydon, Oxted & East Grinstead Railway (COEGR) 1880–84

The Warings' work was recommenced by a new company, the Croydon, Oxted & East Grinstead Railway Company in 1880, with Joseph Firbank as contractor. The Network Rail engineering archive contains a most valuable drawing of the Oxted tunnel shown in section, which records the state of the tunnel as abandoned by Warings and found by Firbank. This sectional drawing throws no light on the curvature of the tunnel, but shows how much tunnelling had been completed by 1867, and how much remained for Firbank to do.

The route traverses hilly chalk country, and passes under some of the highest parts of the North Downs at Woldingham, calling for heavy and expensive civil engineering works. But of course the COEGR company had to adopt and complete the work already done by the SSJR.

## Tunnelling and shoot-hole creation of open railway cuttings

An interesting fact about the Warings' work was that some of the open cuttings were made by the 'tunnelling and shoot-hole' method, this being revealed by Caleb Evans' sketch sections of the unfinished line. Open cuttings, including the approach cuttings to the two permanent tunnels, were initially made as tunnels at track level and later opened out by way of shafts sunk to the tunnel ceiling, the chalk to be removed being excavated and tipped down these temporary shafts into waggons waiting in the temporary tunnel.

*Interior of the Oxted tunnel looking south, showing curvature. One of the shafts is also seen*

The Oxted line, therefore, had more than the two permanent tunnels during its construction. This method of making cuttings is best known on the 1840s line from Brighton to Lewes, having been depicted in a drawing published in the *Illustrated London News*, in 1846. Gripper (1889) confirms that this technique was still in use in the 1880s.

## Canal and railway tunnel design and construction

The eighteenth and nineteenth centuries saw large numbers of tunnels made for both canals and, later, railways (there were very few road tunnels made in the British Isles before 1900 and indeed not many until after World War II). Canal and railway tunnels differ in one main way.

*Exterior of a crew room inside the tunnel*

Canal tunnels are made perfectly level and watertight, for obvious reasons. Railway tunnels (unless below rivers where sumps and pumping are required) are designed to be self-draining. In Surrey, for example, the tunnel floor slopes downwards from a high point part-way through the first Merstham tunnel, so water drains northwards to Coulsdon and southwards to Merstham. The Oxted tunnel drains entirely to the south, the line summit being some way outside the north portal.

This feature made this work of some interest to nineteenth-century water supply engineers, as two square miles of the catchment of the river Wandle basin loses water to the Weald instead of emerging at the springs of the Wandle at Croydon. Both tunnels, after prolonged wet weather, continue to feed streams from their portals, and in recent years the outfall at Coulsdon has caused extensive flooding of property.

There were numerous books published in the 1830s and 1840s intended as guidance for railway builders, and Frederick Walter Simms' book *Practical Tunnelling,* published in 1844, presents a very detailed and complete description of how the Blechingley (sic) and Saltwood tunnels were made for the South Eastern Railway. The Blechingley tunnel is in east Surrey, between Redhill and Godstone, whereas Saltwood is nearer to Folkestone.

Whilst many books about the engineering of curved tracks on surface lines offer advice on their design, the notion of curved tunnels is nowhere mentioned, the unspoken message being that all tunnels of any length should be straight throughout, with, if necessary, very short curved sections at one or both ends.

The crucially important feature for a railway tunnel is to make it self-draining, as already noted above. It is essential,

*Interior of a crew room inside the tunnel. The chimney from the grate directed smoke into the main tunnel*

also, to make pilot tunnels at the outset of the work, draining to lower ground, to avoid groundwater flooding during the tunnelling. By far the most puzzling feature of the Warings' tunnelling is their failure to make this provision.

The southern 1,000 yards of the Oxted tunnel was not excavated at all by 1867. Hardly surprisingly, the works flooded, and had to be bailed or pumped out via the nearest completed shaft, a laborious and expensive process. Lengths of the tunnel had been created to full dimensions from each shaft-bottom, with intervening masses of uncut chalk between them.

Pilot headings, from six to nine feet square, were made through these masses of chalk, but curiously some were at the level of the tunnel floor, and others at tunnel ceiling height. Had such a heading been made at tunnel floor level right through to the south portal, there would have been no flooding in the works.

## Tunnelling works at the surface

Almost all the material dug out to form a long tunnel is dug 'from the inside' and removed up the shafts to be dumped on the hillside above. So for well over a mile of Oxted tunnel, there were seven permanent shafts. Little

*One of the shaft tops, probably shaft 4 or 5. Shaft 3 was sunk in steeply sloping ground which would have been difficult for access for supplies and a difficult location for the stationery steam winding engine which probably operated at that location. Photo by Robin Webster. Reproduced from Geograph under creative commons licence*

or no material was taken out of the portals which, indeed, were often the last places excavated.

The Oxted tunnel was during its creation over 390 yards longer than the completed work, the approach cuttings being made by the 'tunnelling and shoot-hole' method as described. The first-edition Ordnance Survey plans made in or about 1868 show temporary shafts beyond where the built portals were to be. To call these features 'ventilation shafts' to void smoke from steam locomotives is to misunderstand their primary purpose. Spoil extraction shafts are as much a feature of long canal tunnels in use long before steam locomotives were brought into use.

The shafts were where excavated spoil was lifted out and tipped, and any flood-water bailed or pumped out. Presumably the water was disposed of on the adjoining chalky hillside, but trickled back whence it had come, but more slowly than it had been raised.

All waggons, rails, tools, gunpowder, lamps or candles, bricks and mortar, and anything else needed for the work had to be lowered down the shafts. And they were the route to and from work for all the tunnellers, who were lowered and raised in large buckets such as also used for the spoil, for as many years as the tunnel took to build.

Almost certainly, ponies for hauling waggons of spoil underground were used, and they too were lowered and raised in the shafts. In the 1830s, as at the Blechingley tunnel, horse gins were used for lowering and raising men and materials in the shafts.

By the 1880s Joseph Firbank is known to have used stationary coal-fired steam winding engines at shafts, and steam locomotive on surface lines during his railway-building operations.

Tunnel shaft tops were, therefore, exceptionally busy places for the duration of tunnelling. Although Marden Park and Great Church Wood are at present amongst the most tranquil places in Surrey, they would have been quite otherwise in 1865-67 and again in 1880-84. There was then, and still is, no road access to the shaft tops, although several of them can readily be visited by way of public footpaths.

Steep slopes have in some cases, especially shaft 3, to be negotiated to reach them. But many thousands of bricks had to be brought in to reach the shaft tops and stock-piled there, along with all other materials, tools and equipment, not to mention coal for the winding engines. And there were probably stables and workshops as well.

## Great Church Wood

As can be seen from the Ordnance Survey, the line of the curved tunnel allows the railway to avoid burrowing under Great Church Wood which, at the time the tunnelling was done, was probably an important economic asset for the Marden Estate. Creating haulage roads through the wood would have meant felling numerous trees and clearing undergrowth.

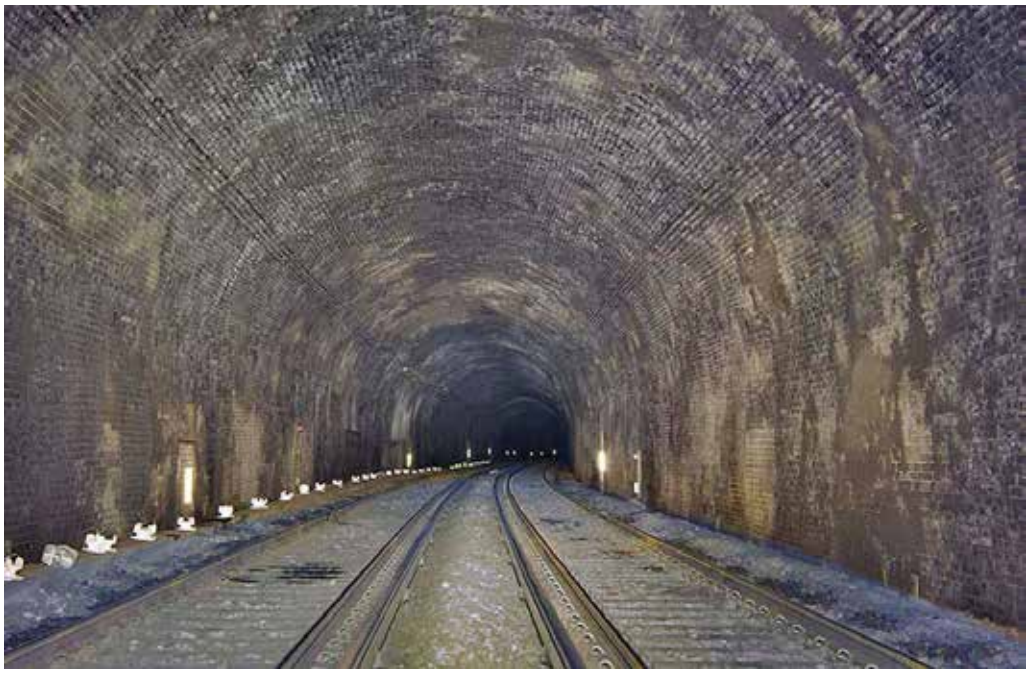
The surveying required to fix the exact locations to sink the shafts would have called for clear sight-lines through the woods, and clear ground on which to lay surveying chains. This may be at least a part of the reason why the tunnel was made curved, to avoid the complications and costs of the straight-line option through the wood.

## Tunnel-driving and shaft sinking costs compared

Obviously the curved tunnel is significantly longer, by more than a hundred yards, than one driven by the shortest direct line from portal to portal. This would have meant additional cost. However, account has also to be taken of the costs of digging and operating the shafts. The Oxted tunnel passes below two high points, with a significant stretch of lower ground between them.

Had the straight line option been taken, some hundreds of feet of additional shaft sinking would have been required, at so much per yard sunk. Added to that would be the additional costs of coal consumption and other supplies. The ground rises steeply eastwards towards and beyond Great Church Wood, and it seems most likely that the relative overall cost of the shafts and tunnel driving were the reason for taking the tunnel below lower ground.

The additional cost of the longer tunnel was probably more than offset by savings on shaft-sinking and



*Interior of the Oxted tunnel looking south, showing curvature*

*Side wall of tunnel interior*

operation. An altogether more economically attractive option might have been a route passing close to the Marden Park mansion and straight through the park, but almost certainly the owners of the estate, the powerful Clayton family, would not have consented to this on environmental grounds, or at least demanded an exorbitant sum for the use of the land.

A much more modern threat to Marden Park was posed when the Oxted line alignment was put forward for the Channel Tunnel Rail Link from London to Folkestone. Thus we still have in Marden Park a highly valued piece of open land where a motor car can barely be heard, and no suburban sprawl of modern housing such as blights so much of the North Downs.

## A surveying problem

Anyone who has been introduced to simple surveying may well have been instructed (as was I at Battersea Park) on open-level grassland where compasses and surveying tapes are easily used.

For a straight tunnel, such as at Merstham, a single surveying observatory tower was built at the highest point above the tunnel, and all the shaft centres where digging was to commence laid out in a single straight line from portal to portal. But how were the shaft centres surveyed on a curve, on steeply sloping land? Were there two surveying observatories, on the two high points? Was a straight base line at some distance, and off-sets, used?

## In the beginning

That the Oxted tunnel was to be curved throughout was of course dictated by the original company's Act of Parliament and clearly shown on the deposited plans and books of reference for the line, and specified by the company's surveyor and engineer. The contractors simply had to create what had been specified.

However, *how* they did the tunnelling was a matter for them. The Waring brothers were Charles [1827-87], Henry [1822-1909] and William [1820-94]. They jointly or severally had over 32 contracts for railway building in England between 1837 and 1867, and another fifteen mostly abroad from 1865 to 1884 or later.

Joseph Firbank [1819-86] gained his first experience of working underground in the collieries of County Durham, and of railway tunnelling in the Woodhead tunnel between Manchester and Sheffield in the 1830s. He had held about 34 contracts for railway work in England and Wales between 1847 and 1880, and another twelve after 1880 after his work at Oxted, none of them abroad. Many of Firbank's contracts included tunnels, amongst them two of the contracts on the famous Settle to Carlisle line across the Pennines.

While the two contracting firms had no part in deciding the curvature of the tunnel, it is curious that such experienced firms – especially the Warings – evidently took no trouble to make the Oxted tunnel self-draining from the outset.

## Sources

By good fortune, a number of sources other than those cited and specifically railway documentation throw some light on questions discussed in this article, but raise new ones! These include 1881 Census data, geological monographs dealing with Chalk hydrogeology, and a posthumous biography of Joseph Firbank.

## Further reading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All photos by Adrian Backshall unless stated.

# Loss of Wellington Road tunnel, Stockport

**Phil Catling**


*Wellington Road Tunnel is highlighted. The tunnel ran from the George Road sidings, under the LNWR main line and the CLC Wellington Road goods depot. A second shorter tunnel is noted to the east under Wilkinson Road*

It is with sadness that we report the loss of the disused Wellington railway tunnel in Stockport town centre. It was originally one of five tunnels on the magnificently named Stockport, Timperley and Altrincham Junction Railway dating from the 1860s; all four closed to trains in 1982.

Of the five, two – the Wellington and Lancashire Hill tunnels – were partially blocked with sandstone rubble from the M60 bypass, while of the other two, one was opened up into a cutting by the simple expedient of removing the cut-and-cover roof, while the Brinnington tunnel became a well-used cycle path in the Reddish Vale nature reserve. The fifth was a short tunnel under Wilkinson Road, removed when the Wellington Road goods depot was redeveloped and is now industrial units.

*Chris Rayner (left) and Phil Catling are seen in the Wellington Road tunnel close to the west end in 2012. Photo Dave Jackson*

Closed to passenger traffic in 1968, the renowned Tiviot Dale station was demolished leaving the tunnels and line for freight use to the Stockport Heaton marshalling yards. Damage to both Lancashire Hill (immediately west of Tiviot Dale station) and Wellington Road tunnels from motorway building works caused a temporary line closure in 1980 and the line never reopened.

Lancashire Hill tunnel lies directly beneath the 3,000-person Dodge Hill air-raid shelter and this along with the 1980 damage meant that both tunnels had huge reinforcements added. The tunnels, along with the connecting cutting which has returned to nature, have become a favourite site for local photographers. Wellington Road tunnel was always the lesser of the remaining tunnels as it was shorter, much more difficult to access and the haunt of many homeless drifters.

*The west end of Wellington Road tunnel in April 1982. The tunnel ran from the George Road sidings seen on the left and under the LNWR main line on the viaduct. Photo Sam Beauchamp*

The recent work to Stockport town centre by the Stockport Town Centre Access Plan (TCAP) meant that a new access route from the main A6 road through to the M60 motorway would lead directly over the buried west portal of the tunnel.

It was hoped that the tunnel could be preserved. Unfortunately the building work caused significant cracking to the Victorian brickwork and a large stretch of the tunnel to the west of the main road was therefore uncovered and filled in.

TCAP engineers saved the datestone from the west portal and it is hoped to include it somewhere in the new roadway. The east portal, still owned and maintained by Network Rail, has been preserved but currently has large gates and fences to deter access.